

MARCH 1951

PRICE 35 CENTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING



NEW YORK'S bus terminal shows many novel features in modern wiring design.



POWER EQUIPMENT and project scheduling streamlines a street lighting job.



ADVANCED electrical distribution design packs ample capacity into manufacturing areas.

A MCGRAW-HILL PUBLICATION

50

TH YEAR



One of three General Electric capacitor equipments recently installed at Los Angeles Fiber Milk Container Plant

By late 1950, American Can had expanded its Fiber Milk Container capacity at Los Angeles to the point that some of the plant's wiring and its main transformers were approaching an overload condition. To remedy this, three G-E capacitor equipments were installed in the basement, each bank containing eight 3-phase, 460-volt Pyranol® capacitors.

This is what happened: Power factor was raised from 68% to better than 90%. Line current was cut by 270 amperes. Because of a kva-demand clause in the power contract, an outright saving of \$125 a month in power costs was realized. The capacitors will have paid for themselves in about 26 months!

*Reg. Trademark of General Electric Co.

THESE ARE THE FACTS. Capacitors relieve feeders and transformers of overload, allow for expansion of load and improve voltage conditions. Also, if your power factor is below 85% and if there is a power factor or demand clause in your power contract, chances are you can make similar worthwhile savings.

Read what capacitors have done for others. Write for a copy of GEA-5167, "A Way to Cut Power Cost." Address *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*



This New Book Can Help You

"Capacitors for Industry" is a new, complete book on the application of capacitors in industrial installations. Full of up-to-date information, it is the work of four General Electric application and design engineers.

"Capacitors for Industry" is the newest member of the General Electric-Wiley book series. Copies may be purchased from John Wiley and Sons, Inc., 440 Fifth Avenue, New York.

You can put your confidence in—

GENERAL  ELECTRIC

How does the **Murray** MAGNETIC BREAKER put *Security* in your Security Lighting?



*Fully
Magnetic*

MAGNETIC ACTION GIVES **MURRAY** CIRCUIT BREAKERS TWO DISTINCT ADVANTAGES

1. After tripping to "off", service can be restored quickly.

In most cases, the use of Murray Breakers means that service can be restored 10 to 100 times faster than circuit protecting devices which do not employ fully magnetic action.

2. Murray Breakers always carry full load regardless of temperature.

Night and day, there are "hot" spots in any group of industrial buildings—overhead heaters, spot heaters, radiators, baking tunnels, furnaces, etc. Because Murray Circuit Breakers are fully magnetic, they trip only on short circuits or overloads. They always carry the full load, regardless of temperature. They never need "derating."

IF YOU WANT TO INSTALL THE BEST... specify *Murray*



**MURRAY
MANUFACTURING
CORPORATION**
1250 ATLANTIC AVENUE
BROOKLYN 16, NEW YORK

Service Entrance & Meter Equipment • Magnetic Circuit Breakers • Switches
Current Limiting Reactors • Crows'nest Aerial Ladders

Write for descriptive folder—clip out the coupon for the complete story of Murray Breakers and Load Centers.

MURRAY MANUFACTURING CORPORATION

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Please send me folder describing the Murray Circuit Breaker line.

Name _____

Position _____

Company _____

Address _____



It's Here! ... a Great NEW APPLETON REELITE

■ Announcing the new, *all new*, Appleton 7S Portable Reelite—a compact, automatic cord take-up reel that solves the countless lighting problems of car-loading, machine inspection, maintenance work—any job that requires good illumination in out-of-the-way places.

Double silver alloy collector brushes—one of many outstanding new features—permit continuous rotation of the entire reel in either direction without power interruption or tangling of the cord. This versatile device furnishes light—or a flexible power source for power tools—when and where you want it. Positive stop action holds cord at desired length, up to 25 feet; then cord is automatically re-reeled when job is done.

The Appleton 7S Portable Reelite is completely encased in steel, finished in baked hammertone enamel. It is easily installed on any 4" octagonal outlet box. Available accessories include six types of handlamps, machine tool connector body or key socket. A vaporproof model is furnished with handlamp. Write for details on this and other Portable Reelites.



270 Pat.
Applied For

Rating:
10A-250V.



Shown above is the New Appleton 7S Series Portable Reelite. At right, the new reel equipped with RE-H3SR handlamp.



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APPLETON

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

50th Year—MARCH, • 1951

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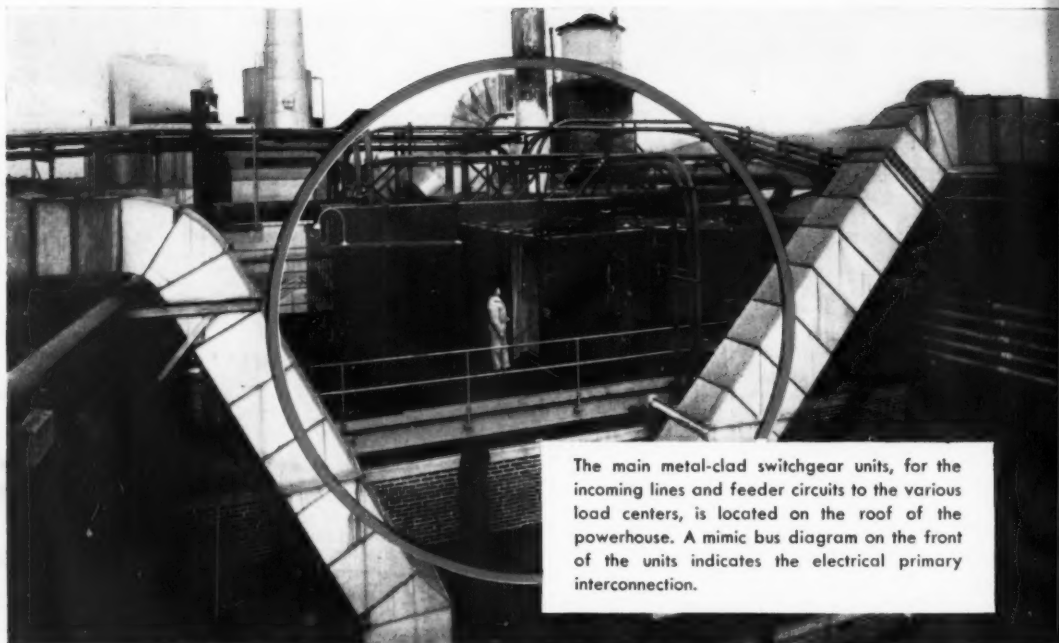
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The main metal-clad switchgear units, for the incoming lines and feeder circuits to the various load centers, is located on the roof of the powerhouse. A mimic bus diagram on the front of the units indicates the electrical primary interconnection.

PUTS SWITCHGEAR ON ROOF saves 10,000 sq. ft. of floor space

Indoor space limited—installation made with almost no interruption of production
—Maintenance will be greatly simplified.

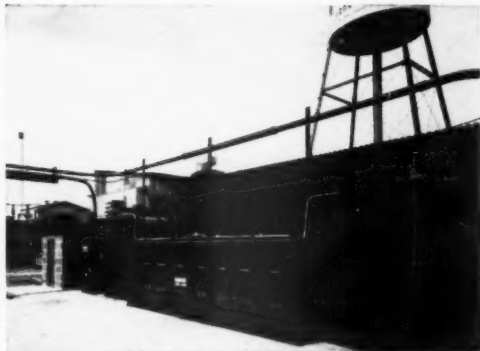
When Scott Paper Company, of Chester, Penna., completely revamped its electrical system to take care of expanded plant output, it made one rather unusual decision. Because indoor space was limited, it put all its switchgear and load-center units on the roofs of the various buildings. The incoming utility power lines, at 13,200 volts, terminate in General Electric outdoor metal-clad switchgear on the roof of the powerhouse, and the 575-volt distribution system is fed through G-E metal-enclosed gear located on roofs of the individual buildings. Distribution between buildings is at 13,200 volts with step-down load-center units.

This type of installation has proved to have a number of advantages. In the case of Scott Paper, 10,000 square feet of badly needed floor space became available for paper making. The entire installation could be made during normal working hours, yet did not interfere with plant production. Likewise, routine

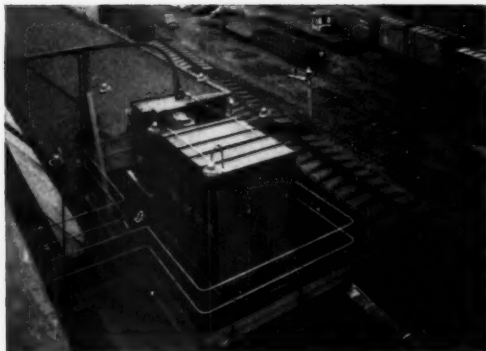
inspection and maintenance can be done without entering the manufacturing areas. All breakers are of the easily-removable type that is so easy to maintain and inspect.

What's more, there's plenty of space for expansion. Provision has been made to double the capacity—by adding transformers and switchgear—when still more electric power is needed later. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*





A double ended load-center unit feeding the large 2300-volt motors in one of the main buildings. Unit consists of two power transformers with air-interrupter disconnects, and metal-clad switchgear units for metering and for the four magne-blast air circuit breakers.



One of several single-ended load centers, which can be doubled in capacity later by adding a second transformer and low-voltage switchgear units. This particular unit uses metal-enclosed gear with draw-out air breakers to 575-volt feeders which serve the paper finishing units.

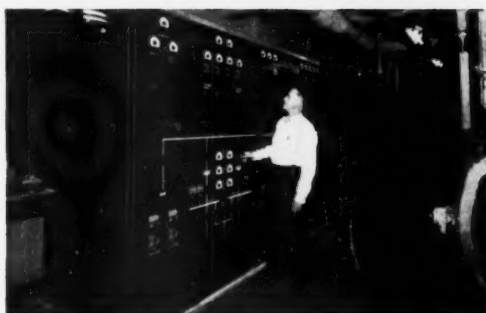
New switchboards simplify control — Increase safety



BEFORE

a definite hazard down the plant.

Front and rear views of the old switchboard which handled all the plant's power at 575 volts. Open buses, breakers, knife-switches, and resistors were



AFTER

Main switchboard is now simply a control board. Incoming line and feeder circuits can all be closed from this one location. No power lines or high voltage is brought to this board at all—and there are no open buses or switches to form a hazard to personnel.

854-33

GENERAL  ELECTRIC



for FUSE ECONOMY... use ECONOMY FUSES

...and CONSERVE *precious Brass and Copper*

"ECONOMY DE-LAY" Renewable Fuses offer you the opportunity to conserve scarce Brass and Copper and at the same time make a real saving in the cost of your Fuse maintenance.

After your first cost of an "ECONOMY DE-LAY" Renewable Fuse, you pay only a few pennies for an "ECONOMY DE-LAY" Renewal Link to restore the Fuse to its original efficiency after a "blow". This is much cheaper in the long run than any other type of Fuse protection you can buy.

The simplicity and unusually fine mechanical construction of "ECONOMY DE-LAY" Renewable Fuses and Renewal Links make replacement quick, easy and inexpensive.

With a reputation for Pioneering and Constant Improvement, ECONOMY has always made its Renewable Fuses and Renewal Fuse Links to meet the maximum of all requirements of "The Standard for Fuses".

Millions of ECONOMY Renewable Fuses have been in service for years, giving low-cost protection to electrical installations. Keep a full stock of "ECONOMY DE-LAY" Renewable Fuses and Renewal Links on hand!

Ask for the ECONOMY Catalog and Price List.

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**ECONOMY
DE-LAY** RENEWABLE CARTRIDGE FUSES

Your Electrical Wholesaler has "ECONOMY DE-LAY" Renewable Fuses and Renewal Links in stock.

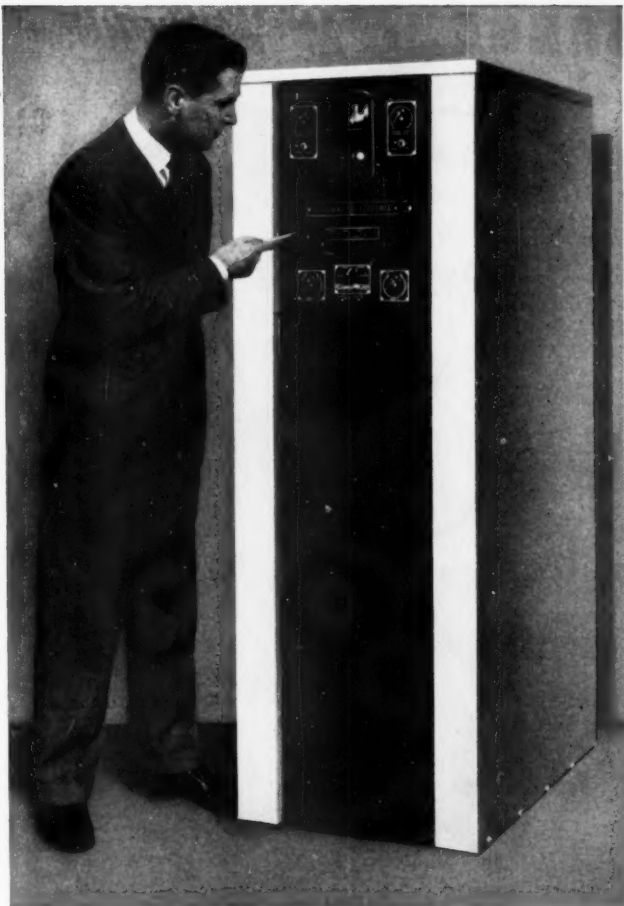
ECONOMY FUSE AND MFG. CO., 2717 GREENVIEW AVE., CHICAGO 14, ILLINOIS

REPRESENTATIVES IN
ALL PRINCIPAL CITIES

New G-E three-phase INDUCTROLS

(dry-type induction voltage regulators)

- Require less floor space than any 3-phase regulators previously available.
- For circuits up to 500 amp, 600 volts and below.
- Will help keep production up—by keeping voltage up.



A new standard line of three-phase "Inductrol" voltage regulators has been announced by General Electric. These regulators have a three-phase winding on a single core—and thus require less floor space than the Triplex assembly which consists of three single-phase regulators on a single base.

These new regulators are completely self-contained, and include a power supply for both control panel and operating motor. They are furnished in attractively styled all-steel cabinets, with all live parts completely enclosed. Ratings up

to 300 load amperes or 34 kva are self-cooled. Higher ratings are forced-air cooled. All are 19 x 27 x 51 inches high or 22 x 31 x 65 inches high.

Poor voltage means sluggish performance of electric equipment—and reduced output. To be sure you are getting the motor performance and the lamp brilliance you pay for, use voltage regulators. For advice on how and when and where to apply them, contact your G-E sales representative or authorized agent. *Apparatus Department, General Electric Co., Schenectady 5, New York.*

4034-76

GENERAL  ELECTRIC

SANGAMO *Heavy Duty* TIME SWITCHES

*Here's the Switch
for continuous day-in-
day-out service*



*yes...the oversize
pure silver contacts
add years of life*



**built to give the kind of service
that means *Less Cost* per year**

Sangamo Heavy-Duty Time Switches are built to give many years of exceptionally dependable switching with complete freedom from maintenance worries.

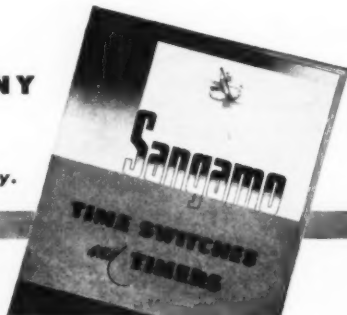
For example, the pure silver contacts are very conservatively rated and minimize troublesome arcing by combining a slow break with a narrow gap . . . In addition, these switches are powered by the special Sangamo-developed low speed motor that means much longer life because it operates with *fewer revolutions per minute* than the motors used in many other time switches.

Sangamo Time Switch Motors are lubricated for life with a Silicone grease that is not affected by temperature extremes . . . timing mechanisms are equipped with machine cut precision gears . . . and they are carefully assembled and tested.

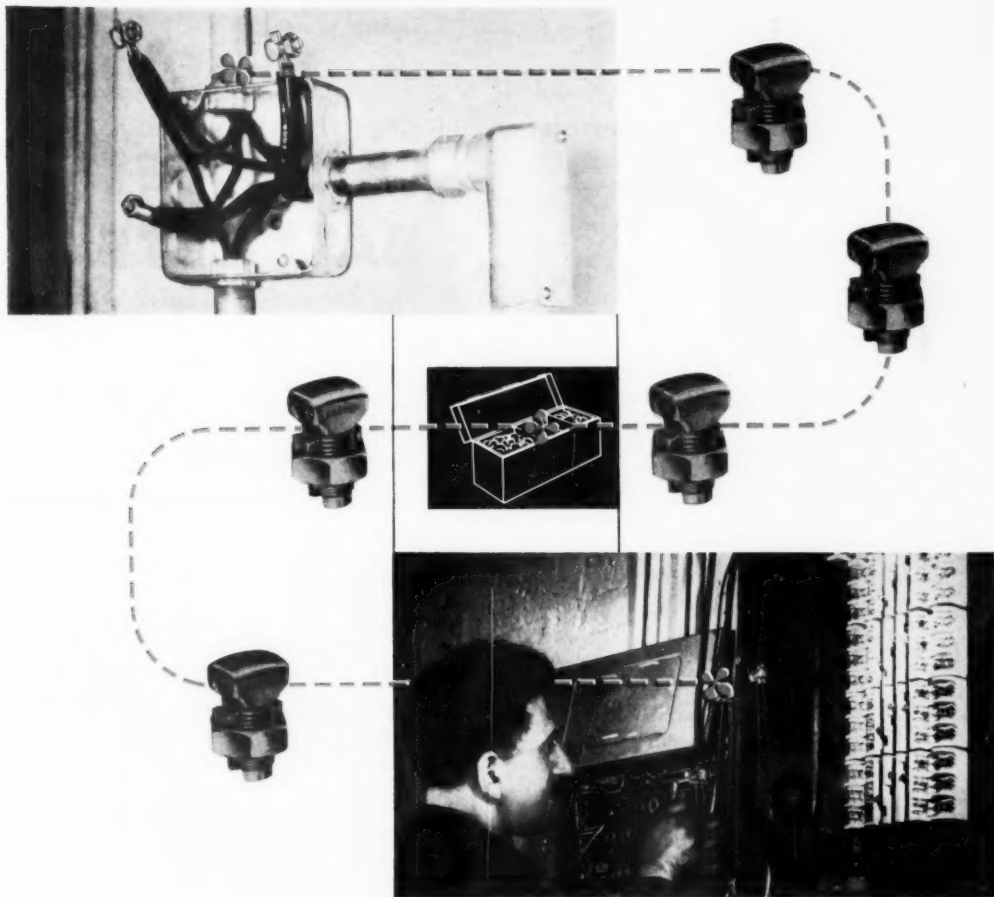
The Sangamo line is complete—a large variety of special control features meet your particular needs. Choose one of these high quality time switches for your next installation. Your electrical wholesaler can supply you.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

Get the full story—write for Catalog No. 1010-A today.



8731-8



here's a connector that lives a DOUBLE LIFE!

Burndy connectors are strongly constructed of high-grade, non-corroding alloy with husky, sharp, uniform threads. That's why you can use Burndy connectors over and over again for *temporary* or *permanent* installations. Today, it's most important to conserve stock. Make your supply go further, save time, reduce costs and be sure of sound connections: *use Burndy connectors...re-use Burndy connectors!*



SERVIT...



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BURNDY CONNECTORS

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CERTIFIED BALLASTS

are *Quiet*

Audible "humming" from a fluorescent ballast is highly annoying . . . yet some people believe this noise is an unavoidable part of fluorescent lighting.

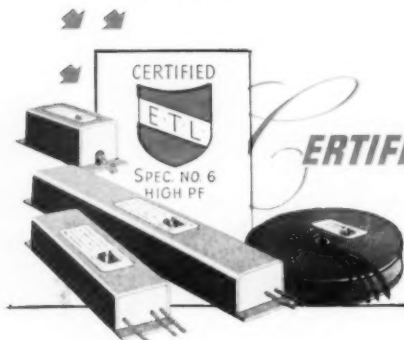
This is not true. Seldom do you hear a **CERTIFIED BALLAST** that is properly installed in a fixture. It operates efficiently and quietly.

Freedom from noise is but one advantage of **CERTIFIED BALLASTS**. You also get...

- Maximum light output (poor ballasts may reduce light by 20%)
- Full lamp life (poor ballasts may shorten lamp life by 1/3)
- Long, trouble-free, dependable service.

CERTIFIED BALLASTS are made to exacting specifications, then tested and checked by Electrical Testing Laboratories, Inc.

• Complete information on the types of **CERTIFIED BALLASTS** available from each participating manufacturer may be obtained from Electrical Testing Laboratories, Inc., East End Avenue at 79th Street, New York, New York.



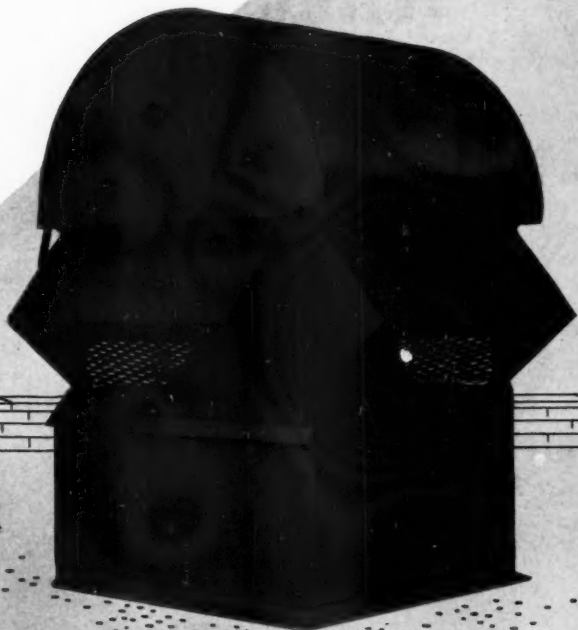
Participation in the **CERTIFIED BALLAST** program is open to any manufacturer who complies with the requirements of **CERTIFIED BALLAST MANUFACTURERS**.

CERTIFIED BALLAST MANUFACTURERS

Makers of Certified Ballasts for Fluorescent Lighting

2116 KEITH BLDG., CLEVELAND 15, OHIO

New ILG type "PRV" power roof ventilator



Model "PRV"
Power Roof Ventilator
(Centrifugal Fan Type)



● Rarely has a ventilating product received as enthusiastic a reception from architects, engineers, and contractors as this new, improved model "PRV" Power Roof Ventilator. It has every desirable feature for positive, controlled ventilation, independent of wind or weather conditions. In a single, weather-tight housing (easy to install, easy to service) you get a complete ventilating unit consisting of self-cooled motor direct-connected to non-overloading, backward curved wheel, plus a selection of air control accessories. No belts, no pulleys, no "extras"! Sturdy, rugged, precision-built, it is available in sizes providing exceptional air deliveries over an unusually large range of pressures (free air to 1½" SP). Each ventilator is backed by the ILG "One-Name-Plate" Guarantee since the complete unit, including the motor, is designed, manufactured and tested within the ILG plant.

To get complete engineering data on this remarkable new development, call nearby Branch Office (consult classified directory) or send coupon today.

VENTILATION

Free! New engineering data bulletin No. 1901 gives you the complete story—features, sizes, capacities, dimensions. Send coupon now!

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Individual _____ Title _____

Address _____ Zone _____

City _____ State _____



Cleveland's New WOMAN'S HOSPITAL

Wired the Modern Way



Exterior view of the recently completed Woman's Hospital, Cleveland, Ohio. Construction costs were over a million dollars.

First floor installation at Woman's Hospital. With Republic "Inch-Marked" ELECTRUNITE E.M.T. and a few simple tools it's easy for the experienced electrician to make strong, concrete-tight installations every time.



with **ELECTRUNITE** **E.M.T. Raceways**

● The old has made way for the new at Woman's Hospital in Cleveland, Ohio. The former hospital building was razed—and today a new, beautifully modern structure stands in its place.

Well protected wiring is a "must" for hospitals. Failure in a wiring circuit is always a hazard, but in a hospital it can be most serious. Therefore, it speaks well for ELECTRUNITE that E.M.T.—the *modern* electrical raceway—stands guard over much of the wiring in Woman's Hospital. A large quantity of ELECTRUNITE E.M.T. was installed throughout the five floors and basement of this new hospital building.

ELECTRUNITE E.M.T. is inspected by the Underwriters' Laboratories, and approved

by the National Electrical and most local codes for exposed, concealed and concrete slab installations.

For safe, dependable wiring protection—ease and convenience of installation—no other raceway affords the many advantages of Republic ELECTRUNITE E.M.T.

CHECK WITH YOUR ELECTRUNITE DISTRIBUTOR

Give him as much time as possible to plan ahead on your requirements. Even though he may be unable to supply all your raceway needs, you can be sure that he will do everything possible to help solve your material supply problems.

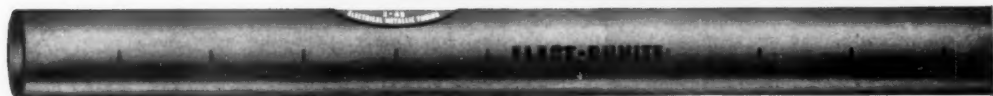
REPUBLIC STEEL CORPORATION

STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO

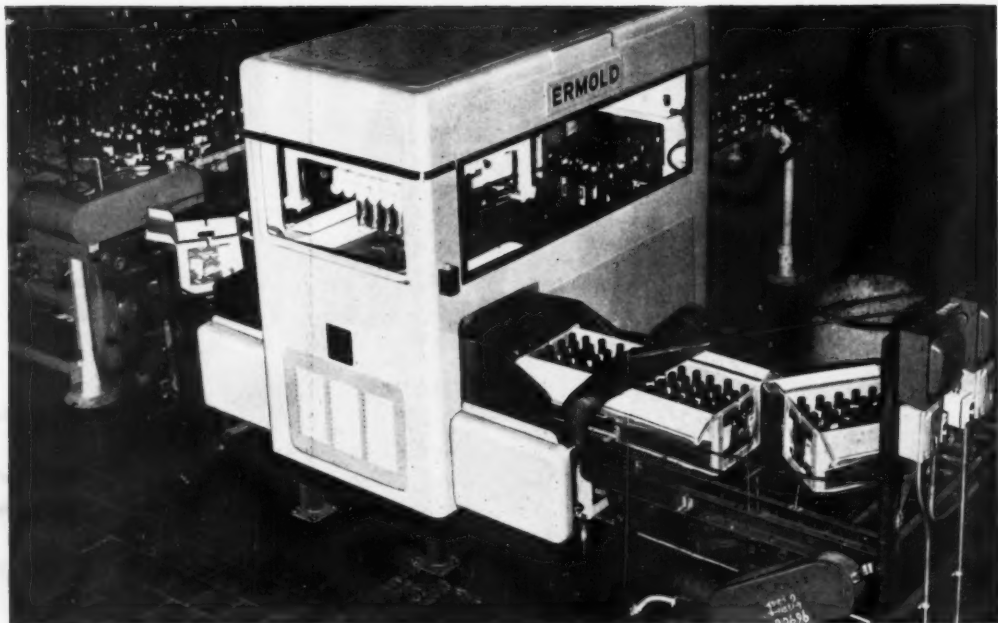
Export Department: Chrysler Building, New York 17, N. Y.



Republic
ELECTRUNITE E.M.T.



LIGHTWEIGHT THREADLESS RIGID STEEL RACEWAY

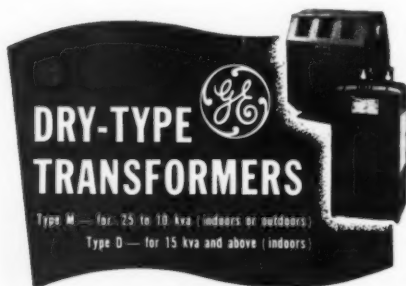


New Automatic Unpacker powered by G-E Dry-type Transformers

"Unpacking and distributing cases of bottles as they return to bottlers is a heavy duty operation requiring dependable voltage supply," says the Edward Ermold Company, New York. We have used a G-E dry-type transformer in our automatic unpacker for its voltage supply. For dependable operation day after day, we've found G-E transformers really do the job."

WHEN YOU NEED DEPENDABILITY SPECIFY

G-E DRY-TYPE TRANSFORMERS



G-E dry-type transformers *look* as if they could do a job, *and they can*. They're designed to dissipate heat rapidly—built for years of reliable service. Top-quality varnishes, specification steels, and thorough inspection give you downright dependability on the job.

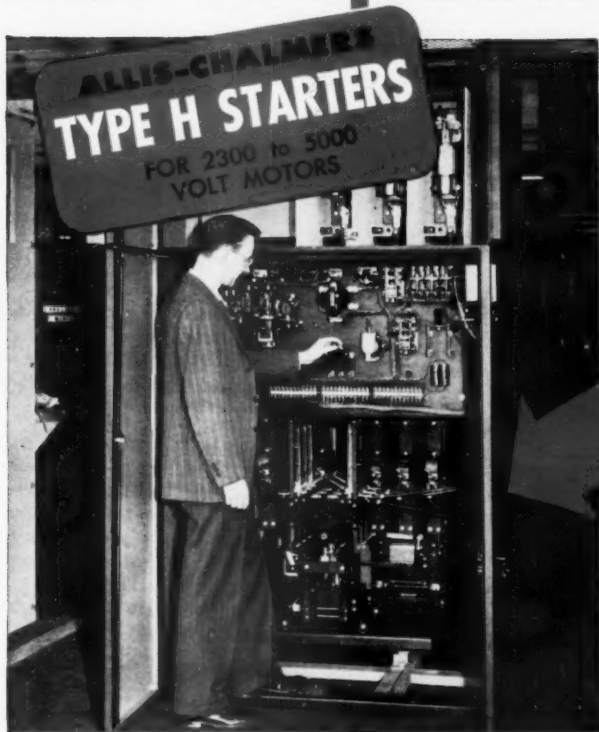
Plan now to cut maintenance and operation costs. Specify General Electric dry-type transformers. For more information see your local electrical distributor, or contact your nearest G-E Sales Office. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

You can put your confidence in—

GENERAL ELECTRIC

411-86

NEW TRUCK MOUNTED CONTACTORS Cut Inspection Time!



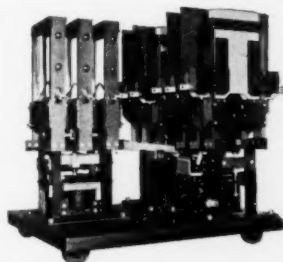
Now, for the first time, air contactors have been truck mounted! The contactors of this Synchronous Motor Controller are mounted on wheels—easy to remove through front or rear hinged doors. Just disconnect the power leads, unplug the control circuits and withdraw the contactors for easy inspection.

You save space! The starter is smaller because room for inspection isn't needed within the cubicle. Truck mounting is a feature of Type H Starters using three air contactors.

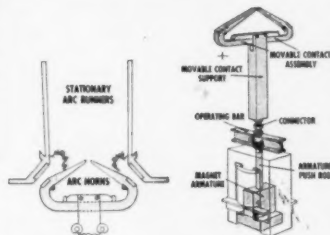
For complete control plus protection of squirrel-cage, synchronous and wound rotor motors up to 1500 hp at 5000 volts . . . all in one attractive steel cabinet that is compact and easy to install . . . specify Allis-Chalmers Type H Starters.

For full or reduced voltage starting, a single starter or an entire control group, check with your nearby A-C representative or send for bulletins 14B6410 and 14B7303.

A-3107
ALLIS-CHALMERS, 930A SO. 70 ST.
MILWAUKEE, WIS.



THREE TYPE 256 AIR-BREAK CONTACTORS are mounted on a common base of heavy gauge metal . . . mechanically interlocked to provide reversing and dynamic braking for a synchronous motor. Base is on wheels—rolls into cubicle on guide rails. This truck mounting provides for quick, easy, unhindered inspection.



DOUBLE BREAK CONTACTS AND STRAIGHT LINE VERTICAL ACTION are combined in Allis-Chalmers Air-Break Contactors to eliminate maintenance factors like flexible contact leads, turning shafts and shaft bearings. These contactors are clean, easy to inspect and maintain . . . accessible in compact, attractive Type H Starters.



ALLIS-CHALMERS

Approved
by
UNDERWRITERS
LABORATORIES

The men who USE them
know the difference!

they like this—
**BETTER
DESIGN**

If you have ever spliced wires and cables in real mean locations, you probably are a strong "booster" for Penn-Union Connectors ---

Because you know how much easier they are to use in close quarters: Working up against a wall...squeezing into small boxes, to join short ends of stiff wire...reaching around pipes, and splicing wires in dark holes where you can hardly see.

LARGER SURFACES

for the wrenches make the Penn-Union connector more practical—you grip it from **ANY** angle, with **ANY** kind of wrench (box, socket or open-end). Developed by 20 years of constant improvement. Accurately made, with rigid engineering inspection. Reusable over and over. Can be furnished in Bronze or Aluminum.

Sold by Leading Wholesalers

PENN-UNION ELECTRIC CORP.
ERIE, PA.

Canada: Dominion Cutout Company, Ltd.,
250 Richmond St. West, Toronto

The COMPLETE Line of Conductor Fittings

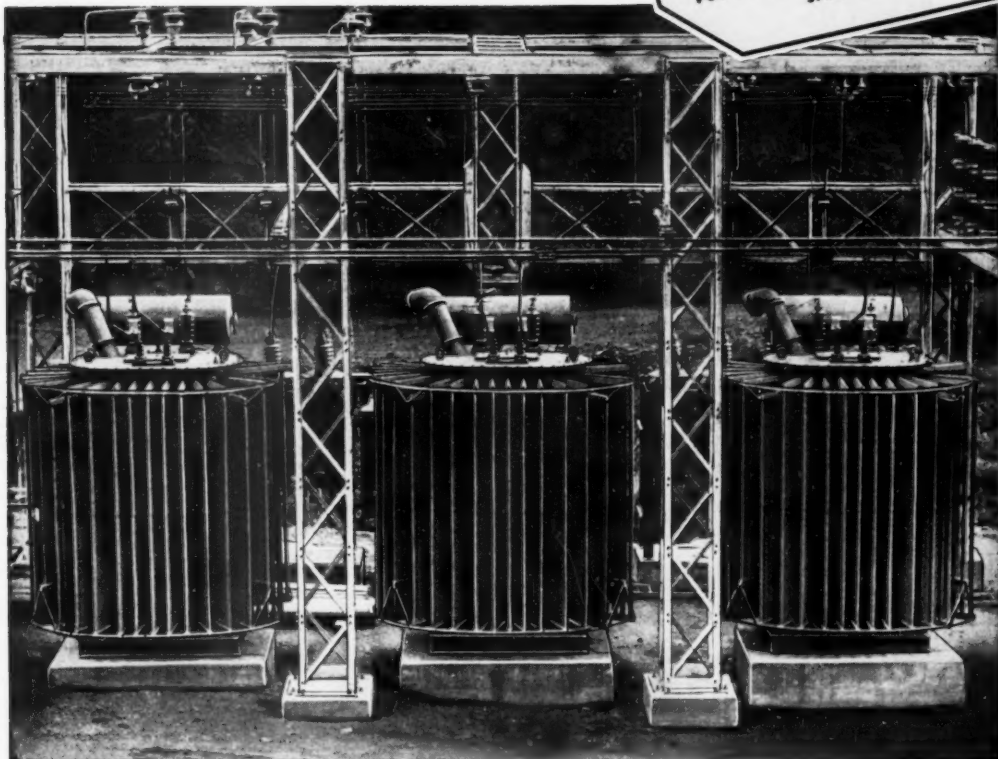
*Far
More*
in use than
any other

PENN-UNION

A DEPENDABLE Link

for Industrial Power Systems

Uptegraff
TRANSFORMERS
POWER • DISTRIBUTION • INSTRUMENT
SPECIALTY



The three 5,000 KVA Uptegraff Power Transformers shown above, serving an industrial plant in West Virginia, are 33,000 volt, 60 cycle, single phase, oil-immersed, self-cooled units.

Uptegraff offers a complete line of transformers for indoor or outdoor

service, with sizes from 1/10 to 10,000 KVA. Types include: Power, Distribution (both dry type and liquid cooled), Instrument and Specialty.

We can quickly meet your needs with dependable transformers designed and built to your specifications.

R. E. UPTEGRAFF MANUFACTURING CO.

**SCOTSDALE,
PENNSYLVANIA**



L-69 FLOODLIGHT

For lighting sports fields and recreation areas General Electric's universally accepted Type L-69 floodlight is your best bet. To improve your sports lighting, consider the simplified installation and maintenance and more light per watt featured by this light.

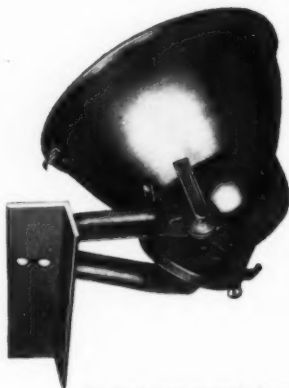
Heavy-duty service at lightest weight is yours with L-69's. Remember, they have simple one-bolt mounting, convenient beam-sight aiming . . . don't require any tools for initial positioning and maintenance . . . have favorite hand-toggle latches. The spun-on, impact resisting tempered plate glass won't break if struck by ball, keeps water, dirt, and insects out permanently.

For your convenience, Floodlighting Plans for Sports and Recreation are available. Get them from the lighting specialist in the nearest G-E Sales Office, or write to *Apparatus Department, General Electric Company, Schenectady 5, New York.*

NOW GET THESE 5 FLOODLIGHT FEATURES



To put the right light in the right place, and to save installation time, the G-E Type L-69 floodlight can be aimed precisely—during the daytime—with the convenient beam sight.



To permit easy removal of particles in case of lamp breakage, the reflector tips over completely. No tools required.

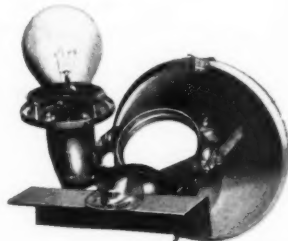


Exclusive L-69 features save time and effort in adjusting and servicing the light. Built-in wrench-type handle eliminates need for tools. Double clamping action holds against vibrations.



Relamping and cleaning is easy. Just flick hand toggle latches, clamp socket housing to trunnion bracket. Hands are free to service light, and reflector need not be disturbed for cleaning.

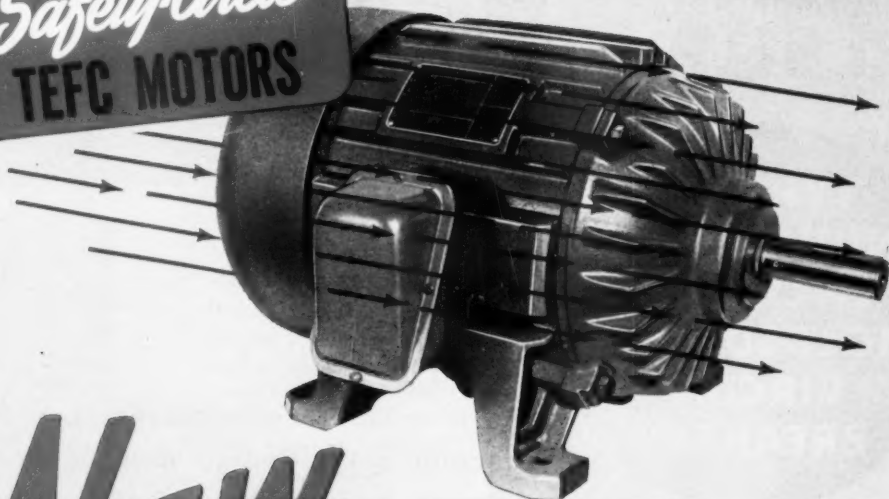
For many installations, floodlight can be aimed while the pole is on the ground with the aid of easy-to-read horizontal and vertical degree scales.



GENERAL  **ELECTRIC**

451-160

ALLIS-CHALMERS
"Safety-Circle"
 TEFC MOTORS



NEW Easy to Clean Resists Corrosion

CORROSIVE ATMOSPHERES CAN'T HURT this Allis-Chalmers totally enclosed, fan-cooled motor because major parts are enclosed in a rigid corrosion resistant cast iron frame! No extra treatment is needed and cast iron's corrosion resistance won't chip off.

Lower Maintenance, Too

No corners, pockets or hidden air passages to collect dirt. Cleaning is the simplest of maintenance operations. Just blow off the dirt with an air hose. Fan and housing design keep cooling air-flow tight against the yoke so dirt does not accumulate and cleaning is seldom required.

Factory Lubricated Bearings

Bearings are lubricated at the factory and operate without attention or cost for years. Extra rigidity of the cast iron frame holds bearings in true alignment under all operating conditions. This gives long bearing life and low operating costs.

Get All The Facts

The new *Safety Circle* totally-enclosed fan-cooled motor is built in all NEMA standard frame sizes from 224 to 505. Call your nearest Allis-Chalmers Authorized Dealer or Sales Office for complete information or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 51B6144.

A-3228

Safety Circle, Texrope and Vari-Pitch are Allis-Chalmers trademarks.

ALLIS-CHALMERS



ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . MARCH, 1951

Sold . . .
 Applied . . .
 Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.



PUMPS — Integral motor and coupled types from 1/2 in. to 72 in. discharge and up.

THEY'LL DO *THE MOST* TO HELP YOU CUT OUTAGE TIME

TYPE ETB INDIVIDUALLY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

Located on a branch circuit when trouble has occurred, an ETB breaker is ready, waiting for immediate reset, to restore power with least time loss.

Already it has acted to localize the trouble, allowing work on other branches to go along undisturbed.

That's help; and you want the most—a circuit breaker most able to withstand severe stress. Rating for rating, the ETB *is the buskiest available*.

You want complete protection. The ETB sizes here—F, K and L—have thermal trip plus a separate instantaneous magnetic trip; thermal to discriminate between harmless and harmful overcurrents and to provide time-delay for safeguarding work schedules; magnetic to give prompt opening when need arises. All are shown in NEMA, Type 1-A steel enclosures.

Know these ETB breakers well. Compare them detail for detail from the standpoint of their ability as outage-time savers. Careful review of I-T-E Catalog 5000, will repay the study you give it.

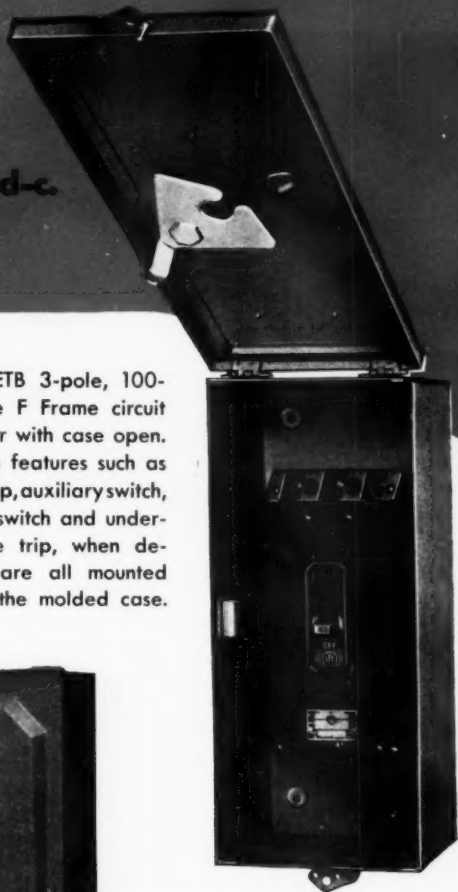
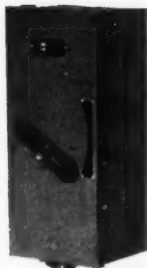
For information on:

I-T-E INDIVIDUALLY ENCLOSED, MOLDED CASE CIRCUIT BREAKERS

Send for Catalog 5000

**100 to 600 amperes;
2 and 3 poles;
up to 600 V. a-c, 250 V. d-c.**

Type ETB 3-pole, 100-ampere F Frame circuit breaker with case open. Special features such as shunt trip, auxiliary switch, alarm switch and under-voltage trip, when desired, are all mounted within the molded case.



Type ETB circuit breakers in NEMA Type 1-A enclosures. Upper left, 600-ampere L Frame; middle, 225-ampere K Frame; lower right, 100-ampere F Frame.



MOLDED CASE CIRCUIT BREAKERS

I-T-E Circuit Breaker Company, 79th and Hamilton Streets, Philadelphia 30, Pa.

Power Switching Equipment: Railway and Industrial Engineering Co., Greenburg, Pa.

Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto

Export Sales: Philips Export Corp., New York



CUSTOMER • UNIT SUB STATIONS • ISOLATED PHASE BUS STRUCTURES • CIRCUIT BREAKERS • MECHANICAL RECTIFIERS • RECTIFIERS • SPECIAL PRODUCTS



ORANGEBURG LAYS FASTEST AND AT LOWEST COST

● That's the reason why more contractors than ever are using Orangeburg Conduit.

Today's conditions call for fast action . . . even with fewer people. Contractors get that action from Orangeburg. It's so light a child can handle it. *Standard 4"* weighs only two pounds per foot . . . heavier-walled *Nocrete* only 3.6 pounds per foot. Orangeburg is easily sawed and tooled on the job. Tapered Sleeve Joints also speed assembly and save time and work.

LIFETIME CABLE PROTECTION

Orangeburg is the conduit most widely used by public utilities, municipalities and contractors . . . and has been for 58 years. They know they can depend on Orangeburg

to provide a permanent raceway for the lifetime protection of cables underground.

For Multiple Duct Jobs. ORANGEBURG STANDARD . . . installed with concrete encasement . . . is the economical construction where banks of three or more ducts are involved.

For Single or Double Duct Runs . . . use NOCRETE, installed *without* concrete encasement. Contractors find it profitable to use *Nocrete* . . . when conditions are favorable . . . for such installations as factories, schools, colleges, hospitals, drive-in theaters, telephone and other communications systems . . . also service entrances, parkway and suburban lighting, airport lighting and communication.

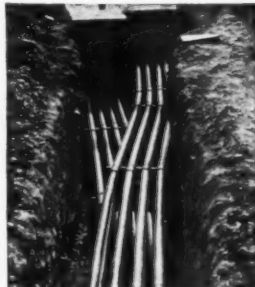


ORANGEBURG NOCRETE

These Time-Tested Features Keep Orangeburg the Leader in Every City and State

1. Will not corrode. Lasts indefinitely.
2. Impermeable wall and tight joints prevent corrosive ground waters from entering.
3. Lays faster and at lower cost than any other type of conduit.
4. Low coefficient of friction keeps pulling tensions on cable to minimum.
5. Protects cable sheath from abrasion when pulled in—also from wear during cable movement resulting from alternate expansion and contraction with changing loads.
6. Resists acids, alkalis, salt, grease, oil.
7. Light, easy to handle and tool on the job.
8. Tough, resilient—will not crack or break when properly handled.

The Orangeburg trademark identifies these valuable qualities. SEND FOR *Free*, Illustrated Folder showing Orangeburg Bend Sections and Angle Couplings. Write today to Dept. EC-3, Orangeburg Manufacturing Co., Inc., Orangeburg, N. Y.



ORANGEBURG STANDARD

ORANGEBURG

FIBRE CONDUIT

STANDARD

Installed with Concrete

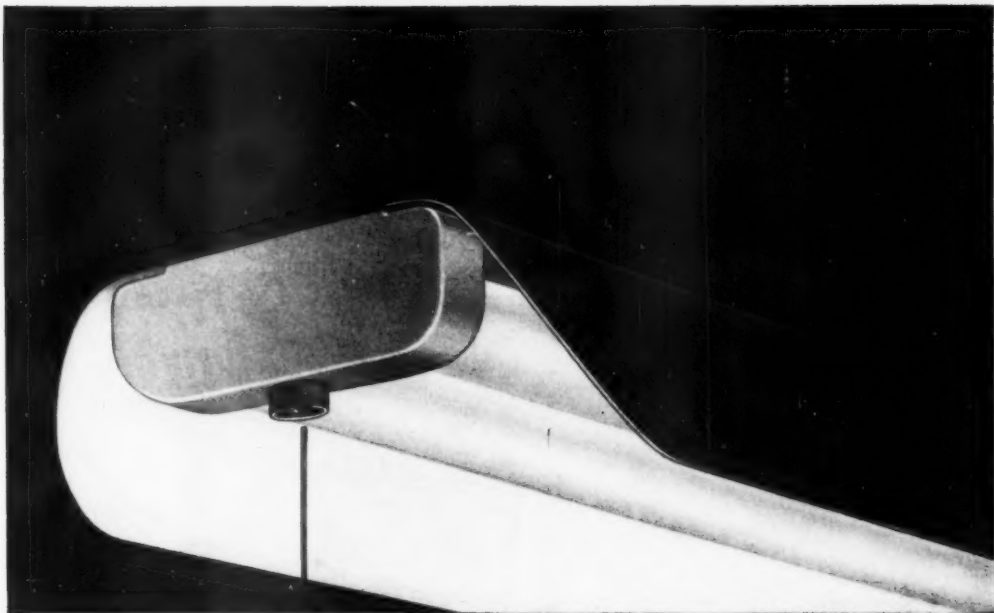
NOCRETE

Installed without Concrete

GENERAL  ELECTRIC
SUPPLY CORPORATION

DISTRIBUTORS,
ORANGEBURG
FIBRE CONDUIT

Graybar
ELECTRIC COMPANY



Red button stops flicker caused by failing lamps

The red button on a G-E Watch Dog® starter is your sign of fluorescent lighting that will pay off in better light and decreased lighting maintenance.

For better light, Watch Dog starters promote even, continuous lighting—because Watch Dog starters banish flicker. When an aging lamp begins to blink, out pops the red button, and the lamp is turned off. When the lamp is replaced, the maintenance man pushes the button and the starter's ready to go again.

For decreased lighting maintenance, Watch Dogs prolong the life of ballasts and starters themselves by eliminating the overheating that results from blinking lamps.

LOOK FOR THE G-E NAME

Make sure all the fluorescent fixtures you install are equipped with Watch Dog starters. Look for the G-E identification, and look for the red reset button that means low maintenance and good light. Write to Section Q65-318, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.

* Registered Trade Mark of General Electric Company



GENERAL  **ELECTRIC**

KEEP EFFICIENCY AT **Top Level** WITH -

ALLIS-CHALMERS
Dry-Type
Transformers

TOP QUALITY CONTROL is constantly maintained in this infra-red paint baking oven. A bank of 12 Allis-Chalmers 37½ kva dry type transformers keeps voltage up — resulting in full lamp temperatures at all times.

ALLIS-CHALMERS DRY TYPE TRANSFORMERS REDUCE POWER COSTS . . . BOOST PRODUCTION OUTPUT

BELOW NORMAL voltages cost money! At 90% voltage you get only 70% of the light you pay for, only 80% of the motor torque, and only 78% efficiency in heating operations.

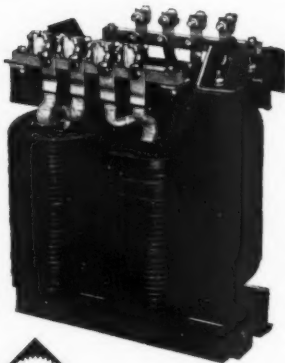
You can correct these low voltages by spotting Allis-Chalmers dry type transformers at load centers. They shorten secondary runs, reducing the amount of hard-to-get copper. They improve lighting, motor and thermal

efficiency. They let you use all the power you buy.

Transformers are stocked country-wide in popular ratings. For information and bulletin 61B6382A contact your nearby Allis-Chalmers dealer or sales office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

Time saving solderless connectors are standard on units 15 through 50 kva, single phase, and 37½ through 100 kva, three phase.

A-3305



ALLIS-CHALMERS



Light!

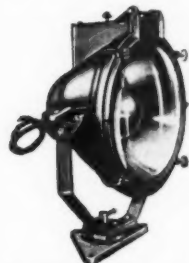
...for PROTECTION



Type DCX-18 Searchlight



Type ADE-14 Floodlight



Type LCE-1120 Floodlight

America is faced with the ever-present danger of sabotage that would cripple vital services and production facilities. Sabotage thrives in darkness. The most reliable and cheapest form of protection against night prowlers is LIGHT!

CROUSE-HINDS Floodlights

project powerful beams of light that bathe all approaches to your property with glaring radiance, killing darkness and shadows and compelling everyone to be more visible at night than in broad daylight.

The protective power of light should be used in all important municipal and industrial locations, including waterworks, dams, pumping stations, gas works and gas storage tanks, electric power plants and substations, factories, mills, mines, bridges, docks, warehouses, railway terminals, tunnels, shops and freight houses, canal locks, and aqueducts, oil refineries, pump houses and storage tanks, telephone and telegraph stations, radio stations.

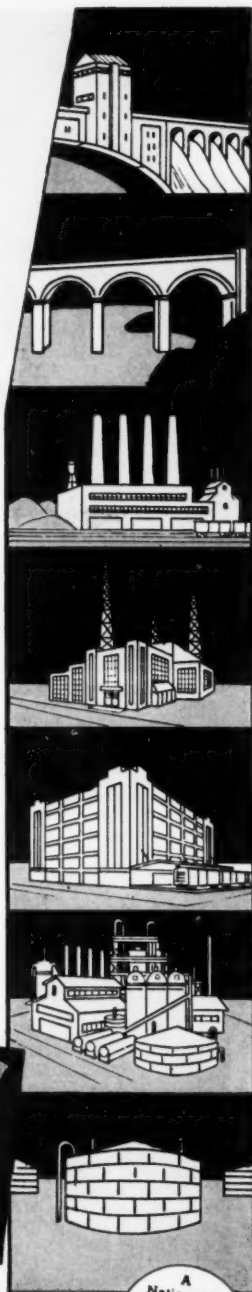
The floodlighting of industrial plants serves a double purpose. It helps to boost production in addition to the security it provides.

Crouse-Hinds offers a complete line of floodlights and searchlights that will meet the needs of any type of protective lighting. Crouse-Hinds illumination engineers have a wealth of protective lighting knowledge that is at your service. Send for your copy of Bulletin 2565, "LIGHT! Protect Your Property."



CROUSE-HINDS COMPANY Syracuse 1, N. Y.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas
Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee
Minneapolis — New York — Philadelphia — Pittsburgh — Portland, Ore. — Salt Lake City
San Francisco — Seattle — St. Louis — Washington. Resident Representatives: Albany
Albany — Baltimore — Charlotte — New Orleans — Richmond, Va.
CROUSE-HINDS COMPANY OF CANADA, LTD., TORONTO, ONT.

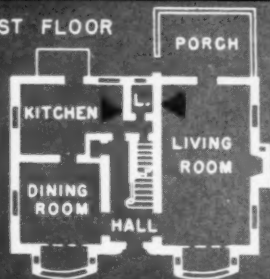




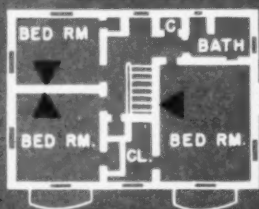
EDWARD H. FAIRBANK, ARCHITECT

Good telephone planning starts here

FIRST FLOOR



SECOND FLOOR



Layout shown includes outlets for portable telephone

One of the first signs of good electrical planning is the triangular telephone symbol. It marks the spots for conveniently placed telephone outlets and permits concealed telephone wiring—two features planned to please clients and make extra profits for you.

Translated, the triangles simply mean a few outlet boxes and connecting lengths of pipe or flexible tubing placed in the walls during construction. The cost is low; the beauty and convenience value, high.

Remember—NO ELECTRICAL CONTRACT IS REALLY COMPLETE UNLESS IT CONTAINS RACEWAYS FOR TELEPHONE WIRING FACILITIES.

BELL TELEPHONE SYSTEM



Type NMO **MULTI-BREAKER** "Plug-in" **BREAKERPANELS**

TRADE MARK

Tailor-made for the job-on the job



Cutler-Hammer Type NMO Breakerpanels make it easy to "tailor" the circuit requirements of each job... either when the panel is first installed... or at any time later when the requirements of one or more of the circuits has changed. How is this done? It is very simple!! The Multi-Breaker unit serving each circuit just plugs into place. Where you want a 15 ampere breaker, you plug in a unit containing the exact number of 15 ampere single pole breakers required up to four. These four pole units are available in 17 different circuit combinations making it possible to obtain the exact quantity and rating of branch circuits with a minimum of effort.

Wiring these Type NMO Multi-Breaker units is also a cinch. You can wire them right in your hands before you plug them in... or you can simply swing them out for wiring as shown, using one of the positive-pressure contact jaws turning on the silvered bus bar as a hinge. And de-

spite the small size of these Breakerpanels that better utilize wall and column space, you get much more gutter space (5 1/4" in the 15" box) with more circuits. The narrow column type actually has double the number of circuits previously available in cabinets of similar height.

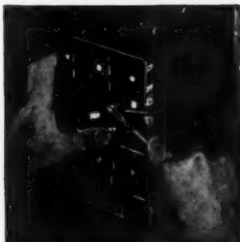
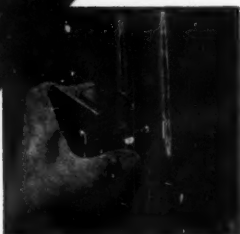
Cutler-Hammer Type NMO "Plug-In" Breakerpanels are now offered in sizes with from 8 to 42 single pole branch circuits in increments of 2. They are available in 120/240 Volts a.c., with 50, 100 and 200 ampere mains (lugs or circuit breaker) with 15, 20 and 30 ampere single and double-pole branch circuits; also, 40 and 50 ampere double-pole branch circuits each of which however, occupies the same space as four single pole 15 ampere breakers. Multi-Breaker units are of the thermal-magnetic type that provide a lag on harmless overloads but instant trip on shorts.

Beyond any doubt, this is the finest protection, the easiest to install, the most flexible, the most compact, and the most modern it is possible to obtain where a large number of branch circuits must be served, as in commercial and industrial buildings, hotels, schools, hospitals, large homes, etc. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wis.

1. Select Multi-Breaker units required by job.

2. Assemble units to panel by "plugging in".

3. Wire them.

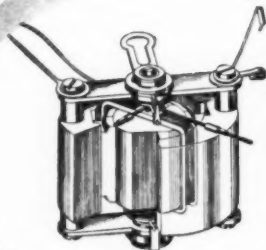


4. Plug them in place again.

**Inherently*

SHIELDED

*The high degree of shielding obtained with the perfected WESTON core magnet mechanism renders Model 901 portables virtually immune to external magnetic fields.



For years instrument engineers have tried to build the magnet inside the moving coil for a more compact, more stable, inherently shielded d-c mechanism. In the Model 901 d-c portable instruments, Weston provides a practical and proved design of this type. The Weston core magnet construction gives uniform flux field over a wide deflection angle . . . withstands extreme

mechanical abuse . . . and is exceptionally well shielded without increase in size and with a reduction in weight. Be sure to get the details of this remarkable development from your local Weston Representative, or write Weston Electrical Instrument Corporation, 589 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and Tagliabue instruments.

WESTON *Instruments*



When insulation must stand 500° Heat ...look to **IRVINGTON'S** Class "H" Line

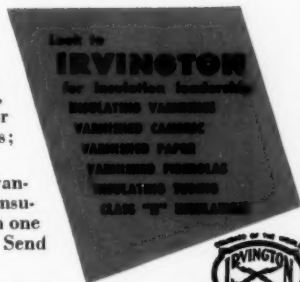
Whether you are winding for service at high ambient temperatures — for increased *continuous* power ratings — for greater *short-time* overload capacity ...

Or designing for space-and-weight savings ...

You will find the Class "H" insulation you want in the complete Irvington line.

Depending on service requirements, your high-temperature insulation job may call for Silicone Varnished Fiberglas*, in yard goods, tape or tubing forms; Silicone Glass Mica; Silicone Saturated or Silicone Coated Asbestos; Silicone Rubber Coated Fiberglas; Silastic**Tape, Teflon Coated Fiberglas.

We make them *all* — we're ready to help you use *each* to best advantage. Write for a free copy of our book — Irvington Class "H" Insulations — it contains samples. Perhaps you'd prefer to talk with one of our engineers. The coupon below is for your convenience. Send it today. No obligation.



*Owens-Corning Fiberglas Corp. **Dow Corning

Send this convenient coupon now

Irvington

VARNISH & INSULATOR COMPANY

6 Argyle Terrace, Irvington 11, New Jersey

Irvington Varnish & Insulator Co.
6F Argyle Terrace, Irvington 11, N. J.

EC-3-51

☐ Please send me a free copy of "Irvington Class 'H' Insulations".

☐ I'd like to see one of your engineers. Please have him phone or write for an appointment.

Name Title

Company

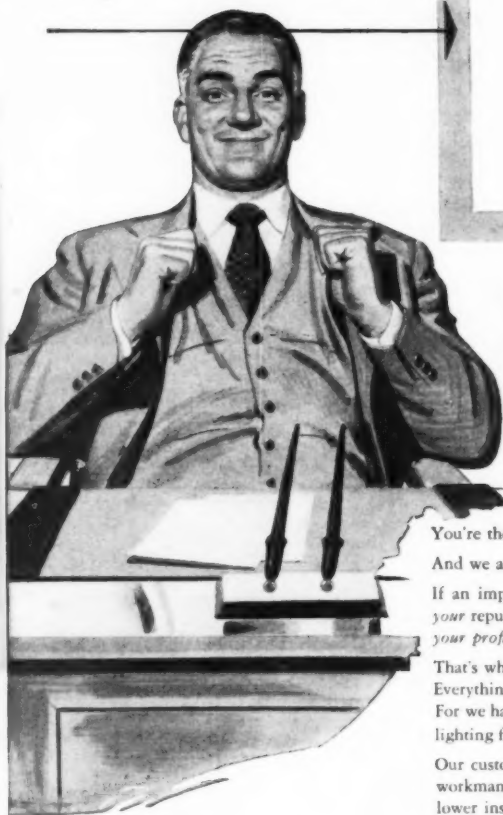
Address Phone

City State

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . MARCH, 1951

29

A "Quote" you can be proud of



FROM "THE BUSINESS OF ELECTRICAL CONTRACTING"

A Report by Robert W. McChesney, Chairman
of the Research and Education Committee,
National Electrical Contractors Association.

"The electrical contractor occupies a position
of great trust and responsibility, a position
which compares favorably to that occupied by
bankers, doctors and other professional men.
In an age of specialization, the electrical con-
tractor is a specialist having the know-how,
the experience, the training, the organization,
and the equipment to provide for the needs of
our great nation in its utilization of electricity."

DAY-BRITE AGREES . . . Our Goal, like the NECA's, is to Help You Protect and Build "Professional Standing" for Yourself and the Industry.

You're the "doctor" . . . the specialist.

And we are one of the groups of people who fill your prescriptions.

If an important ingredient is left out—if inferior ingredients are used—
your reputation, *your* standing in the community and, in the long run,
your profits will suffer.

That's why Day-Brite fixtures are quality-built all the way through.
Everything is the best—*has* to be the best—even if it costs more.
For we have found that *quality pays*. Day-Brite, today, sells more
lighting fixtures than any other one company in the business.

Our customers have discovered that quality materials, quality
workmanship, quality design give them "bonuses" in the form of
lower installation costs, lower maintenance costs, longer life
which more than make up for any difference in price.

We know that this same policy—selling quality, really selling
quality, always selling quality—will pay off for you.

Far more handsomely than cutting prices, cutting profits,
cutting your own throat on straight "bid" business!

Day-Brite Lighting, Inc., 5402 Bulwer Ave.,
St. Louis, Mo.

NOW, MORE THAN EVER . . .

AMERICA MUST SEE
WHAT IT'S DOING

IT'S EASY TO SEE WHEN IT'S



119



Killark

ELECTRIC MANUFACTURING COMPANY

VAN DEVENTER AND EASTON AVENUES
Saint Louis, Missouri

Manufacturers of

CONDUIT FITTINGS

SALES OFFICES AND
WAREHOUSE STOCKS

BOSTON
NEW YORK
ST. LOUIS
PHILADELPHIA
BALTIMORE
ATLANTA
PITTSBURGH
CHICAGO
DENVER
SEATTLE
SAN FRANCISCO
LOS ANGELES
SALES OFFICES
DETROIT
CLEVELAND
CINCINNATI
MINNEAPOLIS
KANSAS CITY
DALLAS

An Open Letter
To Every Electrical
Contractor

Dear Sir:

Over 10,000,000 Killark Alumaloy fittings have been sold to date-- ample proof that they have already been accepted in the field as a major achievement in both construction and design.

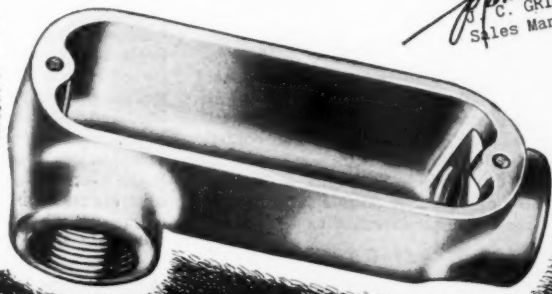
True pioneers, they are the very first fittings in Malleable ALUMALLOY. Die cast under 10,000 lbs. pressure to insure maximum uniformity and strength, they offer all the recognized virtues of aluminum itself--PLUS these many other exceptional advantages never before obtainable from ordinary fittings:

- LIGHT: 60% lighter than iron; easier to handle.
- STRONG: able to withstand stresses far beyond job needs.
- NON-CORROSIBLE: weatherproof clear through...will not rust...resistant to chemical corrosion!
- SMOOTH: burr-free inside and out--to protect hands, prevent wire-skinning.
- CLEAN-CUT THREADS: for faster, easier, cleaner installations.
- SAFE: Alumalloy is non-sparking...never a fire hazard.

We feel thoroughly confident that once you've had on-the-job experience with Killark (6-Ways-Better) fittings, you'll know why we say--and why thousands agree--that "Killark is a Fitting Name to Remember."

Yours for better installations,

J. C. Grindell
J. C. GRINDELL
Sales Manager



Killark

ELECTROLETS

FIRST WITH ALUMALLOY CONDUIT FITTINGS

The C A A approved cables for Airport Wiring



Single and multiple conductor for 600, 3000 and 5000 volt service. Mail coupon below for descriptive literature.

RoMarine® - RoPrene® and RoZone® - RoPrene®

With accelerated defense plans, airport building and improvement represent a real market for electrical wholesaler and contractor, alike.

In specifying RoMarine-RoPrene or RoZone-RoPrene you know you are getting the best. Further, both of these cable constructions are the first to be approved by the Civil Aeronautics Administration for airport lighting and control circuits under Specification L-824.

Approved as Type A-Style RR, RoMarine-RoPrene provides reliable double protection of heat and moisture insulation, plus a RoPrene

(Neoprene) sheath. Approval covers single and multiple conductors for 600, 3000 and 5000 volt ratings. RoZone-RoPrene, approved as Type B-Style ROR, represents the ultimate in high quality, oil base insulation with the same protective RoPrene (Neoprene) sheath. Approval covers 3000 and 5000 volt service.

Both cable types are designed for installation direct in earth or aërially. The protective RoPrene (Neoprene) sheath resists moisture, acids, alkalies and sunlight. Avoid specification difficulties with these fully approved cables.

It Costs Less To Buy the Best

ROME CABLE CORP., Dept. ECM-3, Rome, N. Y.

Please send me the Power and Control Cable Bulletin

Name.....

Company.....

Address.....

City..... Zone..... State.....

ROME CABLE

Corporation

ROME • NEW YORK

From Raw to Finished Wire



The Defense Production Problem

To win out in the struggle for freedom into which the Russian Communists have plunged us we must do at least four things. We must:

1. Speedily carry through a program of defense production which, at its peak, is scheduled to take about one-fifth of our national output.
2. Pay for this program as we go, by methods that will enable us to maintain the effort for an indefinite period — as long as may be necessary to insure peace and security.
3. Manage intelligently and endure intelligently a set of direct government controls which, in certain critical departments, will put our national economy for a time in a hateful straight jacket.
4. See that these emergency controls are not fastened upon us permanently thereby presenting to our Soviet antagonists a major victory for collectivism on our home front.

This is the first of a series of editorials designed to present in the simplest terms these key aspects of our struggle to preserve our free institutions.

A Staggering Task

The magnitude of the defense production job staggers the imagination. Over the next year it calls for a larger volume of goods and services than the 20 million people of the states of New York and New Jersey will use for all purposes. The (London) TIMES has observed that, taken alone, the increase

of defense expenditures which has been budgeted for the federal government's coming fiscal year (about \$30 billion) "is in itself not far short of the total national income of the United Kingdom."

Yet so powerful is the production machine created by free American enterprise that, at the scheduled peak, the defense program will take only about one-fifth of our total national output. The exact form and dimensions of the program will, of course, be hammered out on the anvil of public and congressional debate. But the President's recent estimate of an annual rate of expenditure of \$45-55 billion for defense by the end of this year may well turn out to be somewhere near right.

To meet even these vast requirements of defense production we are in better shape technically than we were when we started to prepare for World War II. Our industrial plant and equipment is greatly improved. Over \$65 billion has been invested in it since V-J Day. Our working force is about eight million larger than it was ten years ago and much better trained.

The difficulty, and it is a very serious economic difficulty, is that we must fit the defense program into a productive machine that has been almost fully extended to meet the needs of a booming civilian demand. The present plan is to step up defense production during 1951 from about 7% to about 18% of our total national output. Because there is relatively little slack in our economy, this means that civilian production at the outset must

be cut back as defense production is stepped up.

The cut-back of civilian goods must be especially severe in the case of products made of metal. This is particularly true of goods that use scarce strategic metals such as aluminum and copper. Of our total defense production program, about half will go for "military hardware" — airplanes, guns, munitions, tanks and the machinery to make them. By the end of 1951 defense requirements are scheduled to absorb most of the metalworking production not required for essential construction and for the spare parts necessary to keep existing equipment running. For a time at least, there will be a sharp cut in the supply of new metal products available to civilian consumers. The defense squeeze on both materials and manpower will also cut sharply into housing and other civilian construction.

For the Short Run — Controls

In the short run there is no answer to the problem of meeting defense production schedules except controls. Sharp reduction of non-defense expenditures by government is essential and would help greatly. But the basic fact is that we cannot increase our total production fast enough to meet immediately both civilian and defense requirements.

Controls are needed, therefore, to switch resources from civilian to defense production, and at the same time prevent the combined demand for critical products from sending prices right through the roof. In the case of many scarce strategic metals such as nickel, copper and cobalt, the task of increasing output is especially difficult because our limited supplies are tucked away deep in the earth in many quarters of the globe.

For the longer pull — and that is what we must face — there is another answer to our defense production problem that is infinitely better than controls. And this time, in contrast to World War II, it is all-important that we get the right answer to our defense production problem for the longer pull and that we get it right now. In World War II we geared our economy to meet the requirements of a

relatively short and decisive conflict. Now our leaders, however they may differ as to methods, are well agreed that, at best, "the conditions under which we labor may persist for ten, fifteen or twenty years." That is General Bradley's phrase.

For the Long Pull — More and Better Production

For this longer pull, the constructive answer to our problem of defense production is clearly more and more efficient production all along the line. It is true that overall we now have the most efficient industrial establishment in the world. But, even so, much of it is far short of attainable efficiency. Some plants using up-to-date equipment and methods are as much as six times more efficient than others in the same industry that are lagging in modernization.

Our Director of Mobilization, Charles E. Wilson, has clearly in mind this problem of increasing our industrial efficiency. The first step in his job, as he conceives it, is to get out an adequate supply of weapons to equip the army, navy, and air forces already mobilized or in process of organization by us and our allies. The second step is to make sure of our capacity to produce both "military hardware" to meet any increased requirements and the maximum possible volume of goods for civilian use.

In concentrating on more and more efficient production, Mr. Wilson is squarely on the beam. We can attain his objective — by sustained effort on the part of each one of us backed by up-to-date industrial methods and equipment.

If we do that, we can maintain indefinitely an adequate defense effort and at the same time enjoy a standard of living higher than any other in the world.

Additional production and more efficient production are our surest safeguards against our two most menacing enemies on the home front—the deadly inflation that can destroy our free economy, and the strangling government controls that can destroy our political freedom.

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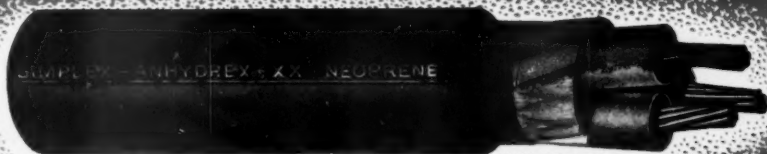
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	Transite	Other
Total Therm. Res. to Dielectric Loss (C watts/ft.)	5.66	6.17
Total Therm. Res. to Copper Loss (C watts/ft.)	4.44	4.95
Temp. Rise from Dielectric Loss (C)	1.9	2.1
Allowable Rise for Copper Loss (C)	59.1	58.9
Allowable Watts per ft. cable	4.44	3.96
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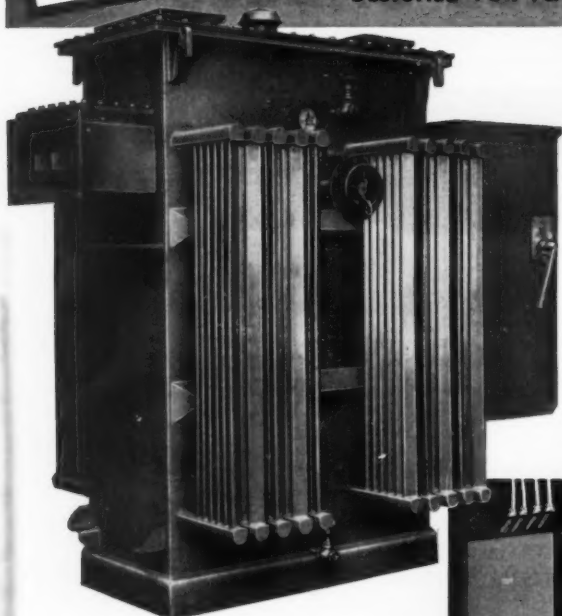
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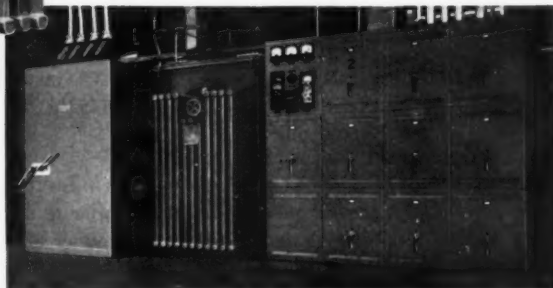
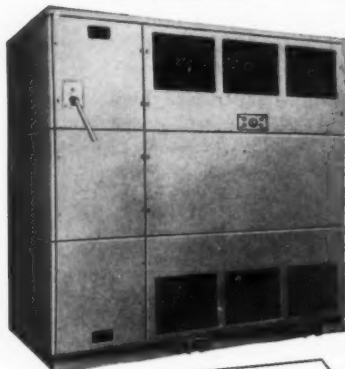
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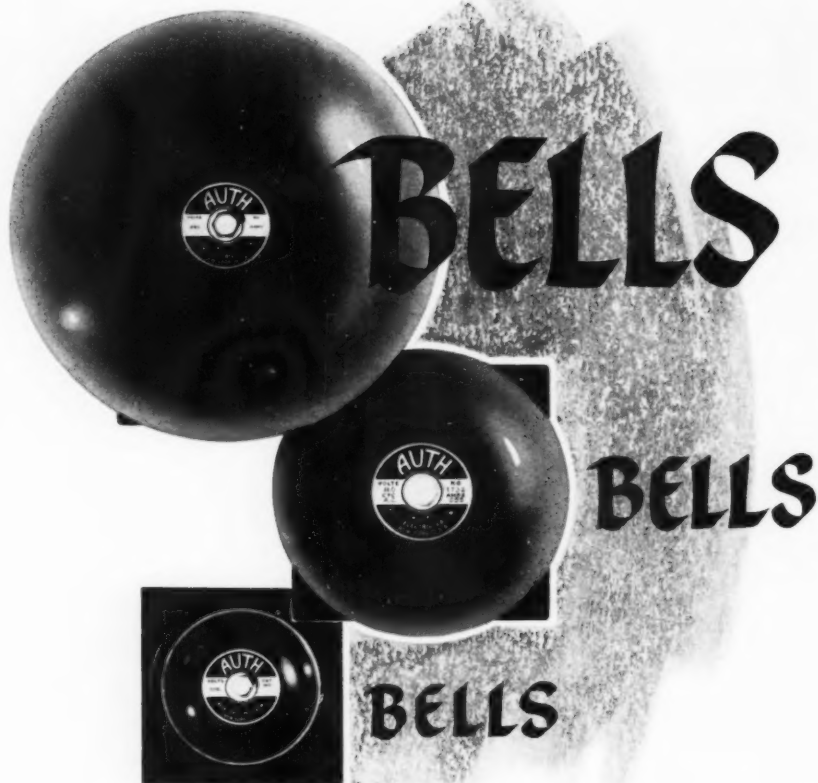
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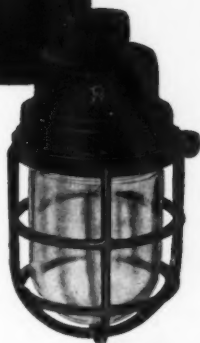


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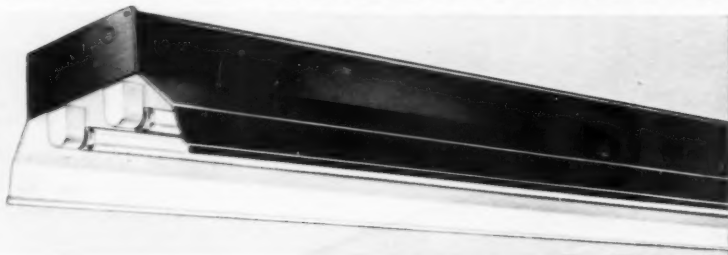
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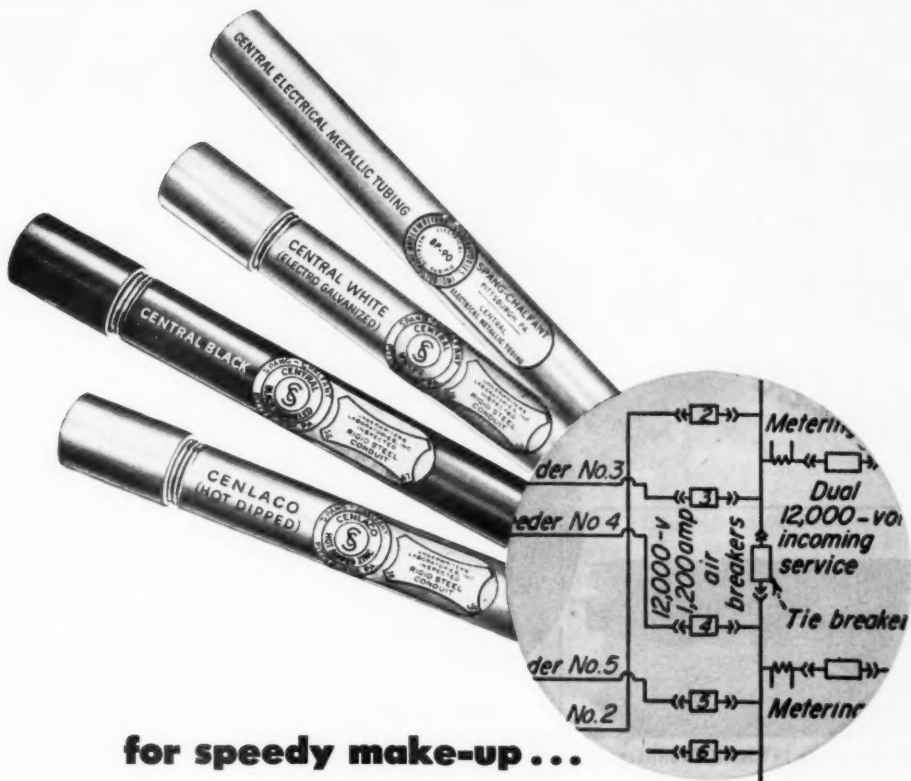
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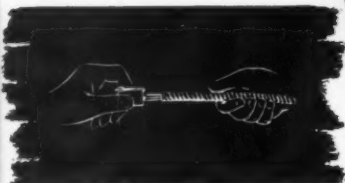
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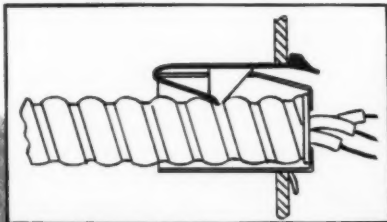


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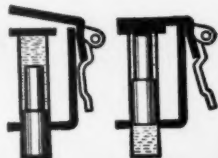
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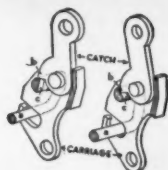
1. MAGNETIC-HYDRAULIC TIME DELAY

HEINEMANN Magnetic Circuit Breakers are available with any one of three different inverse time delays controlled by a hermetically sealed trip unit. The breaker acts instantly on excessive overload or short circuit, but is not affected by minor overloads or temporary inrush current.



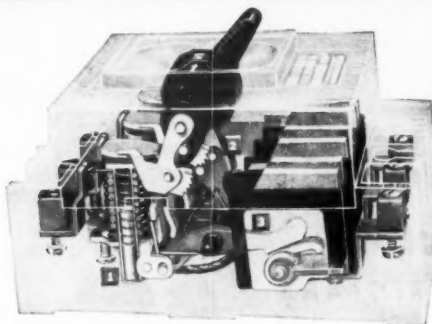
2. HIGH SPEED LATCH

One of the fastest operating latch mechanisms known. It functions with minimum friction, opening the breaker with the least mechanical delay and independently of handle operation.

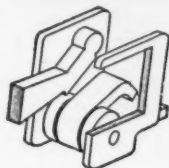


3. MAGNETIC HIGH SPEED BLOWOUT

It adds speed to the arc interruption. Magnetic blowout contacts are mounted in individual arcing chambers carefully insulated from each other. As the value of the current to be interrupted increases, the quenching effect becomes greater due to the intensified magnetic blowout field.



Heinemann Magnetic Circuit Breaker showing location of (1) Time Delay (2) High Speed Latch (3) High Speed Blowout



This breaker has entirely magnetic action. The full time delay provided for is available up to rated current, as it does not depend on any thermal unit and is independent of surrounding temperature.

The point at which the breaker becomes instantaneous is in direct ratio to the rating of the breaker (10 times the breaker rating). For example, a 15 amp. breaker will trip instantly on a 150 amp. current.



HEINEMANN ELECTRIC COMPANY

97 PLUM STREET

TRENTON, NEW JERSEY



When you need tape -
here's your **GUARANTEE** of

ACCURATE

QUALITY ELECTRICAL

TAPES

**Non-Deteriorating
Easy Tear-Off
High Tensile Strength
Maximum Dielectric**



BLUEPRINT FOR KNOW-HOW!

For over a quarter century, ACCURATE Tapes have enjoyed a reputation for quality among electrical men, everywhere. One reason for this steady demand is the modern plant that economically mass-produces the finest tape that money can buy. ACCURATE specializes in tape making—combining finest materials with experienced methods. ACCURATE tapes for the electrical industry are of consistent excellence—a consistency reflected in every roll bearing the familiar ACCURATE label. The next time you need tape, you'll find it's good business to make yours ACCURATE! For complete catalog, call or write the Accurate Mfg. Co. at 1000 10th St., N. J.—Dept. 2.

ACCURATE FRICTION TAPES



Quality made of highest grade rubber and finest cotton base. Affords maximum mechanical protection. Available in Standard and A.S.T.M.-Specification grades.

ACCURATE RUBBER TAPES



Offers high elasticity, excellent cohesion, high dielectric strength and super aging qualities; made in both Standard and A.S.T.M.-A.A.R. grades.

TAPE TIPS:

FOR ELECTRICIANS



Use rubber tape that coheres without heat or extra pressure. That's Accurate Tape! Easier to apply and actually improves with age. Remember—it's Accurate Rubber for greater electrical strength, Accurate Friction for positive mechanical protection!

ACCURATE PLASTIC TAPE



This caliper reduces bulk in tight spots. Strong mechanically and offers high dielectric strength. Recommended for use wherever plastic tape is practical.

ACCURATE

YOUR BEST BUY IN TAPE

MORE THAN A QUARTER CENTURY OF TAPE SPECIALIZATION

YOU CAN BE **SURE**.. IF IT'S
Westinghouse



One Set of Connections ***THAT'S ALL!***

No need to install separate switches and protective devices with Westinghouse Dry-Type Transformers, Types AJRB and AVRB. They have circuit breakers built in!

It's a better installation, too. The integral breaker gives three-way protection . . . something no combination of transformer and external protectors can do. Because the breaker is located inside the transformer case, it is actuated by (1) overcurrent, (2) temperature, or (3) by both in combination. Greater safety

for equipment on the line! Better protection for the installation!

Available in ratings from 100 to 15 kva (Type AVRB) and 10 to 3 kva (Type AJRB). Other dry-type transformers without breakers are available.

Ask your Westinghouse representative for further information, or write for Booklets B-4009 and B-4439. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-70577



Westinghouse

DRY-TYPE TRANSFORMERS

BUSINESS BUILDING PROGRAM

FOR ELECTRICAL CONTRACTORS

SMASH ALL

Personalized Mailing
Campaigns... Ad mats...
Spot announcements...
Speeches... News stories...
Backed by National ads
and big TV show.
**DON'T MISS THIS
Amazing Opportunity!**



Get behind
this Sign

It's the greatest campaign you've ever seen... a personalized program... to blanket your entire territory.

You'll get 3 (three) separate, powerful, personalized mail campaigns imprinted with your own name... mailed by Sylvania to every prospect on your list.

Also, a 44-page book: "A Simplified Method of Planning and Selling

a Fluorescent Lighting Installation."

National advertising and the big, weekly TV show "Beat the Clock" will also tell millions about you... the man who displays the Sylvania Qualified Lighting Contractor sign.

Remember, it's all yours... every thing FREE except the postage. The coupon brings you full information. Mail it NOW!



SYLVANIA

FLUORESCENT TUBES; FIXTURES; SIGN TUBING; WIRING DEVICES; LIGHT BULBS; RADIO TUBES; TELEVISION

RECORDS



Beginning with big, national ads in Time, Newsweek, Business Week and other important magazines, featuring the Sylvania Qualified Lighting Contractor sign, the campaign includes a complete folder of new business aids. Extra seals for your trucks and windows, radio spot announcements, ad mats, speeches, and news stories.



Here's a gold mine of lighting information. Shows typical lighting installations. Tells how to figure lighting levels, how to make fast estimates. Answers scores of questions. Don't miss it!

...with this most complete and powerful Sylvania sales campaign ...

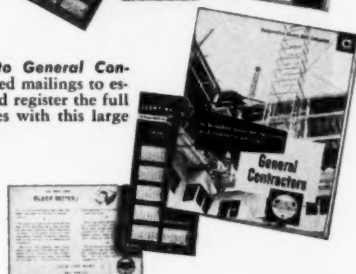
Direct Mail Campaign to your local Stores, Offices, Factories. Here are 6 separate mailings ... each imprinted with your name, address, and telephone number. Mailed to your prospects by Sylvania on a pre-arranged schedule.



3-Piece Campaign to Architects. A strong, personalized campaign selling the advantages of your close cooperation and valuable services.



Special Campaign to General Contractors. 3 personalized mailings to establish your name and register the full scope of your services with this large important group.



But, don't delay! Mail the coupon for this broadside TODAY! It gives you complete information about this wonderful new business building program.

Sylvania Electric Products Inc.
Dept. L-6103, 1740 Broadway
New York 19, N. Y.

I'd like to know more about this new Sylvania program. Send details to:

Name _____
Company _____
Street _____
City _____ Zone _____ State _____

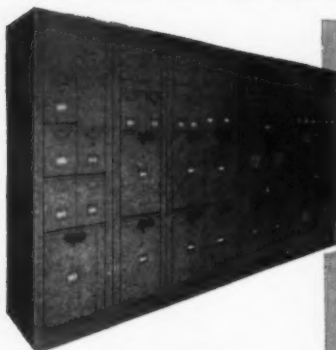
ELECTRIC



PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; PHOTOLAMPS; TELEVISION SETS

Standardized for *ECONOMY...*

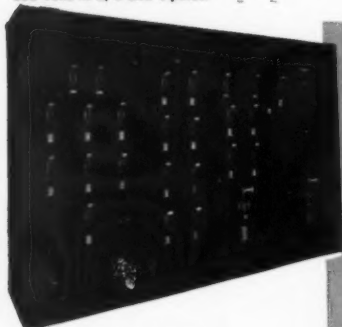
Tailored for *EFFICIENCY!*



Ⓣ KLAMP SWITCHFUZ TYPE

A safety-type switchboard incorporating the latest features and design . . . an extremely compact unit with almost unlimited electrical capacity . . . greater operating efficiency with less maintenance—safer operations with dead front safety type enclosures and safer, more efficient switching with Ⓣ Klampswitchfuz or Snufarc (hinged, pull-out type) switches. Excellent for disconnect service on lighting and power circuits.

Capacities: KLAMP SWITCHFUZ 30 to 600 amps. 250 volts AC or DC and Ⓣ SNUFARC: 30 to 200 amps. 600 volts in 2, 3 and 4 poles.



Ⓣ SHUTLBRAK TYPE

A type similar to the Klampswitchfuz, designed for frequent operation of switches. Totally enclosed, this switchboard features the Ⓣ Shutlbrak switch . . . a front-operated, horsepower-rated industrial switch with quick make and break operations and interlocking fuse doors that permit access to fuse compartment only when switch is "Off."

Capacities: 30 to 1200 amps. 250 volts, AC or DC and 600 volts AC in 2, 3 and 4 poles.



When it comes to dependable, economical and efficient light and power distribution, Standardized Ⓣ Switchboards are your answer.

The flexible plan introduced by Ⓣ of assembling complete sections and units into standardized enclosures, not only provides all the advantages of a "Tailor-Made" switchboard, but affords substantial savings in cost.

Standardized Ⓣ Switchboards are factory assembled and shipped ready for connection of main and branch circuit cables. Units can be arranged singly or grouped, because all sections readily fit together. Removable end walls permit the addition of sections to either side. The number and capacity of switches are supplied according to your specifications.

Want to know more about these safe, efficient, long-lasting, trouble-free Switchboards? Just see your nearest Ⓣ representative, listed in Sweet's, or write to . . .



Frank Adam Electric Co.

ST. LOUIS 13, MISSOURI

Makers of BUSDUCT • PANELBOARDS • SWITCHBOARDS • SERVICE EQUIPMENT • SAFETY SWITCHES • LOAD CENTERS • QUIKHETER

Our 60th Year

PARKWAY CABLE

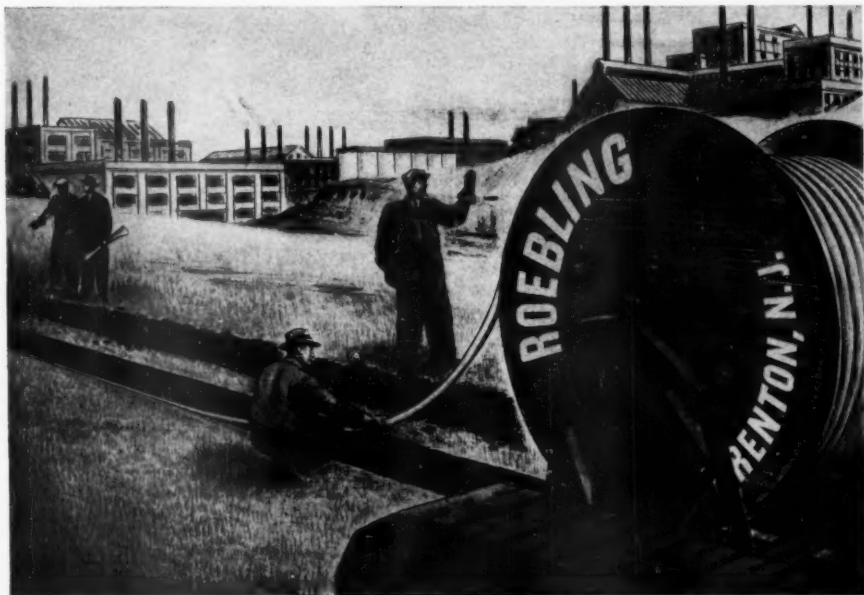
Saves the cost of duct systems

FOR GENERAL POWER SUPPLY and distribution circuits, Roebling Parkway Cable is outstandingly efficient and economical. This cable is laid directly in the ground, in a shallow two- or three-foot trench. And after it's installed, Roebling Parkway will give you thoroughly dependable, uninterrupted service — always.

Roebling Parkway Cable is made in both single and multiple conductor types — either solid or stranded — in a range from 600 to 5000 volts. Both

types are furnished with metallic armor or with a non-metallic, ROEPRENE sheath which affords full physical protection.

Large quantities of Roebling's complete line of electrical wires and cables are now required in the national rearmament program. You can count on the Roebling organization and Roebling distributors, however, for the best deliveries and service that they can give. John A. Roebling's Sons Company, Trenton 2, New Jersey.



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Atlanta, 934 Avon Ave. * Boston, 51 Sleeper St. * Chicago, 5525 W. Roosevelt Rd. * Cincinnati, 3253 Fredonia Ave. * Cleveland, 701 St. Clair Ave., N.E. * Denver, 4801 Jackson St. * Houston, 4214 Navigation Blvd. * Los Angeles, 214 S. Alameda St. * New York, 19 Rector St. * Oceanside, 1920 E. 2nd St. * Philadelphia, 230 Vine St. * San Francisco, 1740 17th St. * Seattle, 900 1st Ave., S. * Tulsa, 321 N. Chayenne St.

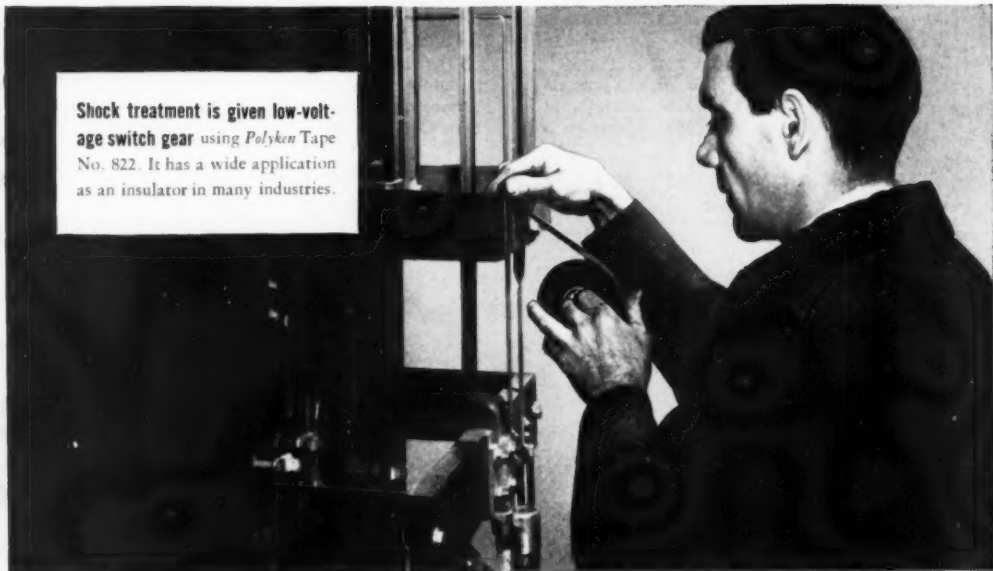


THE NEW Polyken® INDUSTRIAL TAPES

TAILORED TO YOUR JOB



Shock treatment is given low-voltage switch gear using Polyken Tape No. 822. It has a wide application as an insulator in many industries.



$$\frac{822}{10,000} = 0$$

This formula is a long way from scientific, but right on the button when translated. It means that Polyken Industrial Tape No. 822, over 10,000 volts, equals no shocks, no corrosion. Although the picture above shows a low-voltage application, No. 822 gives equally good high-voltage protection.

Polyken No. 822 is a polyethylene plastic-backed pressure sensitive tape. It is only 9 mils in thickness, yet with its polyethylene backing, has a dielectric strength of 10,000 volts, a power factor of .005 and insulation resistance of 106 megohms.

It has a moisture vapor transmission rate of 0.25 grams per 100 square inches for 24 hours at 80°C. This means that Polyken No. 822 provides excellent protection against

corrosion of switch gear parts exposed to moisture or salt and chemical-laden air. Because of the elastic properties of polyethylene it will conform to odd-shaped surfaces.

A few seconds' thought will probably bring to mind some applications for this tape in your plant. Our engineers will be glad to discuss them with you... no obligation, of course.

FREE SAMPLES. Write today for complete engineering data, plus samples of Polyken No. 822. Address Polyken, Dept. ECC, 222 West Adams Street, Chicago 6, Illinois.

Polyken Industrial Tape, Department of Bauer & Black, Division of The Kendall Company

In Electric
Exhaust Ventilators
THIS ISN'T ALL



The entire unit fits flush with the finished ceiling or wall.



The motor is rubber mounted to insure quiet operation.



Only the attractive, chrome-finished grille is visible.

"The blade's the thing"

**Blo-Fan's Blade is
Out of this world!!!**

That's right—the Blo-Fan Blade is "out of this world" in design, construction and performance . . . Unusual design of Blo-Fan's blade is the secret of its superiority. The fan portion scoops up large volumes of air while the blower element expels it with great power . . . Made in one piece and dynamically balanced, Blo-Fan's blade is the result of 26 years of experience in manufacturing home ventilators . . . Blo-Fan operates at a moderate, quiet speed, moving more air—quickly, quietly, with greater efficiency.

SPOT VENTILATION AT THE POINT OF AIR POLLUTION
For Kitchen, Bath, Game Room and Laundry.

3 SIZES—with Blo-Fan you have a choice of models, depending on room size and air change required. Specify by model number to insure the right Blo-Fan for the job.

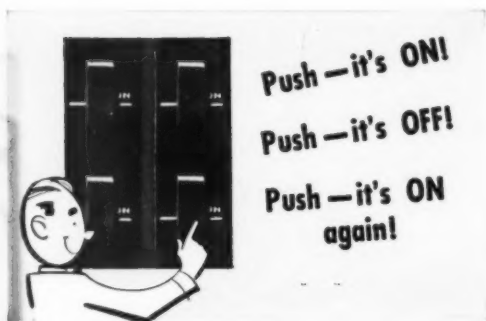
Blo-Fan AMERICA'S MOST IMITATED HOME VENTILATOR

ANOTHER **Blo-Fan** EXCLUSIVE
9-Speed Switch
This 9-speed switch is an exclusive feature on Blo-Fan Model 210 . . . At low to medium speeds, Blo-Fan easily disposes of steam and fumes, handles the normal volume of steam and fumes (like burning the toast) and but in emergencies (like burning the toast) a higher speed will clear the room immediately.

PRYNE & CO. INC. BOX E-351, POMONA, CALIFORNIA
Manufacturers of Pry-Lites, the original recessed lighting fixtures with snap-on fronts.
EASTERN FACTORY: NEWARK, NEW JERSEY
WAREHOUSES: LOS ANGELES, SAN FRANCISCO, CHICAGO, ATLANTA

Pushmatic® Electri-Centers . . . first in circuit protection and control

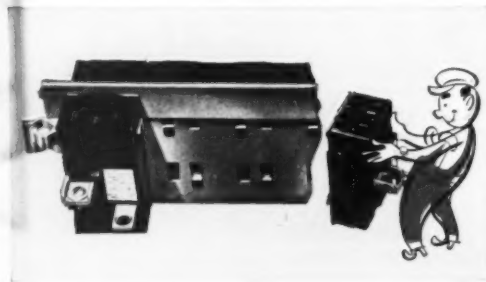
- Simplest switching!
- Surest protection!
- Most flexibility!
- Easiest installation!



Simplest switching. Easy as ringing a doorbell! Push of finger switches the current either ON or OFF. If Pushmatic is automatically tripped by short or overload, just push and service is restored. No bothersome resetting by hand . . . no fuses to buy. Only Pushmatic offers simple push-button switching.



Surest protection. Pushmatics operate with split-second precision when over-load or short occurs. Automatic tripping is entirely independent of manual operation. For installations subject to unusual temperature variables, Ambient Compensated Pushmatics carry 100% of their normal rating at any ambient temperature between 30°F. and 150°F.



Most flexibility. Compact Pushmatics are identical in size and contour, regardless of rating or type. Each unit can be quickly, easily inserted or removed from a panel without disturbing other units. Units may also be interchanged any time to meet changing electrical requirements.



Easiest installation. Compact Pushmatic Electri-Centers fit almost anywhere . . . provide large wiring gutters, easy removal of interior assembly, complete accessibility of all electrical connections. And there's a Pushmatic to meet every load condition: THERMAL-MAGNETIC and THERMAL-MAGNETIC with exclusive AMBIENT COMPENSATING FEATURES. Ratings of 15, 20, 30, 40 and 50 amperes, 1 pole, 120 V., or 2 poles, 120-240 V., A.C. Order now!



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Pioneers in flexible electrical distribution systems

BULLDOG ELECTRIC PRODUCTS COMPANY
DETROIT 32, MICHIGAN • FIELD OFFICES IN ALL PRINCIPAL CITIES
IN CANADA: BULLDOG ELECTRIC PRODUCTS OF CANADA, LTD., TORONTO

See Pushmatic before you specify or buy any circuit breaker

Washington Report

Metals shortages are beginning to hit the electrical industry hard. Copper is the most serious, but steel, zinc, aluminum, nickel, tungsten and others are having their effect as defense production speeds up.

Copper is the heart of the electrical industry's business. The only practical substitute is aluminum, also scarce. Lack of copper is already slowing down expansion of new defense plants and facilities, and conversion of existing plants for defense or defense-supporting production. NPA sees no improvement in copper supply in the near future, but is attempting to divert this important metal to essential war supporting industries, including the electrical industry, after military and stockpile requirements are met.

Steel shortages are also slowing down production of such important electrical products as conduit, low voltage distribution equipment, lighting fixtures, etc., but are less serious than copper shortages. Zinc, used for galvanizing conduit and for other purposes, is extremely tight and is affecting current production schedules of conduit.

Relief from metals shortages for the electrical industry is under study by NPA. Some actions have already been taken, others are expected which will provide increases through the second quarter. For example, end use limitations on copper, steel and aluminum are being imposed. Cutbacks on amounts of metals that may be used by producers of non-military items are already in effect. And DO ratings and special directives are being issued for many essential civilian programs to permit greater support of military programs. Adoption of the Controlled Materials Plan on July 1 will eliminate most of these current problems. Under CMP, steel, copper and aluminum will be allocated to producers of electrical products, based on their individual requirements for defense and essential civilian orders.

Single band DO ratings are bogging down. As an interim measure until CMP is in effect, NPA is upping percentages of steel, copper and aluminum for which DO orders must be accepted by producers and fabricators. This will cut back the available supply for production of civilian products.

Motor repair shops may soon get some relief on magnet wire through an MRO order (maintenance, repair, operating supplies). Until such order is issued, they may file an "appeal" to NPA on the basis of individual hardship. These appeals should be supported by complete data on DO orders on hand, and relationship of the DO-order customers to defense production, health, sanitation or food production and supply.

Construction expenditures for 1951 are predicted by NPA at \$25 billion, down only \$3 billion from last year. But the pattern will change. Industrial plant construction is expected to double 1950 volume, with possible priorities. Hospitals, schools, and churches are exempt from construction controls, as are small individual jobs under \$5000 for any consecutive 12-month period. Housing will drop from 1,400,000 starts in 1950 to about 850,000 in 1951. Some housing will carry DO ratings. Commercial construction is permitted now by NPA authorization only, through 18 field offices. Amusement and recreation construction is banned.

Standardization of products is now being given consideration by NPA, the idea being to thereby save manpower and materials.

Square D Raintight Enclosures with INTERCHANGEABLE HUBS



"Off-the-Shelf" Selection!

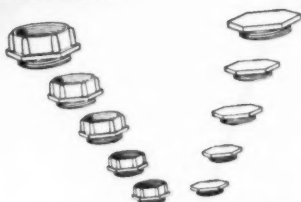
New Interchangeable Hubs for Square D raintight enclosures solve the problem of more flexibility in stocking and installation. Customer requirements can now be filled with "off-the-shelf" selection of the right hub size for any enclosure without excessive inventory.

Type RO raintight devices have extruded openings, threaded for interchangeable hubs. Any one of several sizes can be quickly screwed into place. Threaded joint eliminates need for grounding strap. When no hub is required, a closing cap can be used to seal the opening.

Type R enclosures without openings remain available for those areas where hubs are not used.

All raintight enclosures with interchangeable hubs are Underwriters' approved.

Write for Bulletin 6100. Address: Square D Company, 6060 Rivard Street, Detroit 11, Michigan.



NEW FLEXIBILITY



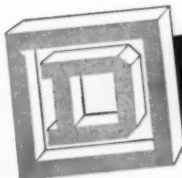
Hubs, in $\frac{3}{4}$ ", 1", $1\frac{1}{4}$ ", $1\frac{1}{2}$ " and 2" sizes, fit tapped openings in top endwall of Type RO raintight enclosures.



Closing caps can be used to seal off tapped opening in Type RO enclosures when no hub is required.



Closing caps and hubs are separately packaged—ten of each size or type in a carton.



ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

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SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

... at a Glance

Washington

Washington roundup, which is produced monthly by Berlon C. Cooper, moves up front to a feature page and will appear hereafter just ahead of, or immediately following, this page. Reports, comments and directives from many Washington sources are gathered by the McGraw-Hill Washington staff. Those pertaining to our industry are channeled to Cooper. Late in the month, right up to "closing," he goes to Washington and covers the departments and offices which are working on controls which affect electrical construction, installation and maintenance. Material is weighed and appraised against background and trends, and condensed into "Washington Report." We want to make this feature as timely and useful as possible, and we cordially invite suggestions that will help us do the job better.

Bus Terminal

Electrical work on the new Port Authority Bus Terminal in New York is a striking example of the complexity of modern electrical system design and installation. Here are reclosing breakers, switching interlocks, centralized operating control, central dispatching, voice announcements and illuminated directional signs, a small city of stores and offices where tens of thousands of passengers are sorted out to thousands of buses smoothly and efficiently. Carl Johnson, Port Authority electrical engineer, tells some of the highlights of the job beginning on page 65.

Circuit Safety

Hook-up of control devices on power operated equipment frequently offers a variety of possible wiring arrangements. Some present hidden dangers to operators. Thomas R. Hughes, electrical safety engineer for the Division of Industrial Safety of California, has prepared a series of articles on practical safety considerations in control connections. The first, "Remote Control Circuit Safety", appears on page 78. In view of the increasing use of centralized control and dependence upon reliable operation of the control devices for operation safety, we urge close study of his recommendations.

New Names

Up front on the Contents page the careful readers will note two new names on the list of people who have a part in providing you with the best technical information we can find.

J. F. McPartland, Jr. has been handling our Reader Service operations since November. He sees to it that your postcard inquiries get prompt and expert attention from members of the staff or from outside consultants.

Walter J. Prise, Director of Industrial Service for The Maintenance Co., Inc., joins our list of industry consultants. His counsel has already been most helpful on maintenance problems. He also authors a timely feature article in this issue, "Planned Maintenance" on page 72.

DATES AHEAD

National Electrical Manufacturers Association—Edgewater Beach Hotel, Chicago, Ill., March 12-15.

RLM Standards Institute—Special Meeting, Edgewater Beach Hotel, Chicago, Ill., March 14.

Electrical Maintenance Engineers Association of Southern California—Fifth Annual Industrial Electrical Show, Shrine Convention Hall, Los Angeles, California, March 15-17.

Edison Electric Institute—17th Annual Sales Conference, Edgewater Beach Hotel, Chicago, Ill., April 2-5.

Chicago Electrical Industry Trade Show—Sponsored by Electric Association of Chicago, Sherman Hotel, Chicago, Ill., April 2-5.

Midwest Power Conference—Hotel Sherman, Chicago, Ill., April 4-6.

Illuminating Engineering Society—Southern Section, Atlantic Hotel, Miami Beach, Fla., April 9-10.

National Industrial Service Association—Annual Convention, San Antonio, Texas, April 15-18.

Chamber of Commerce—39th Annual Meeting, Washington, D. C., April 30-May 2.

National Materials Handling Exposition—International Amphitheatre, Chicago, Ill., April 30-May 4.

National Fire Protection Association—Annual Meeting, Detroit, Michigan, May 7-11.

Illuminating Engineering Society—Canadian Section, Hotel Frontenac, Quebec City, Quebec, May 9-12.

National Association of Electrical Distributors—Atlantic City, N. J., Week of May 20th.

Illuminating Engineering Society—Great Lakes Section, Hotel Gibson, Cincinnati, Ohio, May 24-25.

Edison Electric Institute—Denver, Colo., June 4-7.

Canadian Electrical Manufacturers Association—General Brock Hotel, Niagara Falls, Ont., September 26-28.

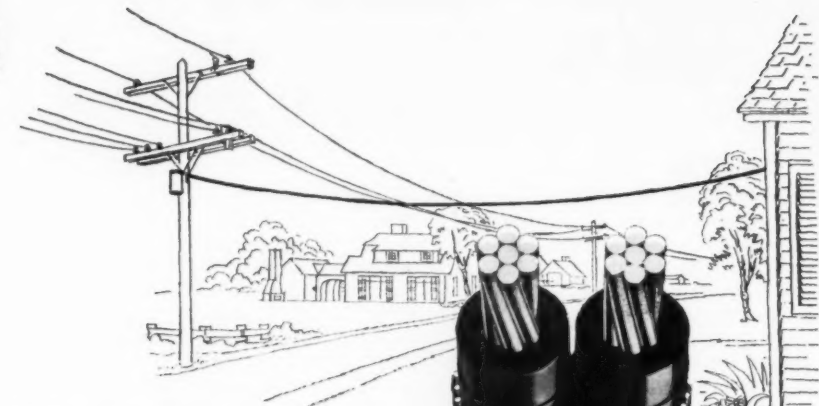
Illuminating Engineering Society—National Technical Conference, Hotel Shoreham, Washington, D. C., August 26-September 1.

National Farm Electrification Conference—Hotel Gibson, Cincinnati, Ohio, October 9-10.

National Electrical Contractors Association—Annual Convention, Shoreham Hotel, Washington, D. C., October 9-12.

look

what
you
get
when
you
buy



SILVALINE

If you're looking for a longer lived, more weather resistant, more dependable service entrance cable—take a good long look at what Silvaline* Type SE with true URC Weather-proof protection offers you.

1.

GENUINE URC SATURANT—not an inferior substitute—makes Silvaline's durable fibrous covering indefinitely resistant to weather.

2.

TOUGH NEOPRENE TAPES cover each individual conductor — increase resistance to heat, moisture and weather ... in 2 colors, black and red — give the preferred means of conductor identification.

3.

OVER-ALL-BRAID COVERING provides high resistance to deterioration and adds life to the covering.

4.

SILVER-FINISH COATING provides clean handling and an attractive surface ... makes greatly improved base for house paint — permits use of URC saturant and finish without discoloring externally applied paints.

41355

Write your nearest *Anaconda Sales Office or Distributor* today. Find out the full details on how Silvaline can do a more dependable job, more economically. *Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.*

*Trademark



the right cable for the job

ANACONDA®

WIRE AND CABLE

Defense Wiring

MUCH DISCUSSION in control agencies and industry circles these days is about conservation. The potential supply of critical materials has to be spread over military demands and the more or less essential needs of a going civilian economy.

MILITARY NEEDS will come first. This point of view is inherited from past war agency criteria and still popularly accepted. But the immediate outlook of limited military action and rapidly accelerated production facilities, gives the situation a possibly different scale of urgency. A section of busbar, a set of stator coils, or a dry type transformer could well have much greater strategic importance at this time than their copper weight equivalent in naval ammunition.

ANOTHER DIFFERENCE in conservation policy is presented by the time element. In the past war, we overloaded motors, we used lighter gauges of metal, less adequate corrosion resistance, poorer insulations, substitute lighting fixtures and we made them do. The outlook at all times was toward a limited duration. We have no such outlook today. The facilities we provide may have to stand up to a generation of more or less active mobilization or wartime use.

TO SPREAD THE SUPPLY of scarce materials under such conditions is more difficult than under the conditions which existed in the 40s. Skimping, substitution and sub-standard design are dangerous and wasteful devices when there is no logical assurance of limited life requirements. The place to curtail now is in end use in preference to product quality and specification. In fact, some quality improvement in materials and parts destined for essential industrial applications would be well advised.

THAT WOULD MEAN fewer civilian products but better ones, fewer new homes but better wiring in those built, fewer new electrical appliances but full quality in those available. Such a policy would permit growth and progress on a limited scale and some maintenance of economic values.

THE CHOICE is before many government agencies today. Shall we build only two buildings, fully modern and employing the best of engineering and product design, or three buildings, sub-standard in facilities and a prideless hodge-podge of substitution and compromise? It seems to us that in reviewing projects, consideration should be given not so much to those which use the least quantities of critical materials, but to those which use them to the best advantage.

THE HEAVY HAND of emergency standards and minimum quality had a useful purpose in the limited duration of World War II. It might have again in all out war. But in mobilization for great industrial, military and economic strength, if a job is worth doing at all, it is worth doing the best way we know how.

William T. Stuart



IT'S ALWAYS RIGHT[™]

and right on schedule

... with wiring materials via Graybar

You're sure every item on your wiring materials and supply order will be right for the job—and if you schedule ahead with Graybar, you'll stand the best possible chance of having everything arrive on the job site when it's needed. You know all the items will fit together properly. Because you can depend upon Graybar delivery commitments, there'll be no waiting for conduit to come from one supplier . . . boxes and fittings from another . . . wire from a third. And your order gets an important "plus" of personal interest, for Graybar is wholly owned by its operating and retired personnel. From the man who takes your order to the one who packs it, we're anxious to serve you well.

EXPERT HELP WHEN YOU NEED IT

For help in planning complicated systems or solving difficult wiring problems, a Graybar Inside Construction Specialist is available. His recommendations, supplementing the knowledge of your local Graybar Representative about materials and delivery, will help keep your projects moving "right on schedule".

A single source for all your needs

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WIRING A BUS TERMINAL

New Port Authority Bus Terminal in New York involves many novel electrical problems in serving a large building unprecedented in design and function.

By Carl Johnson
*Electrical and Mechanical Engineer
Port Authority of New York*



ELECTRICAL work in the new Port Authority bus terminal designed by Port Authority engineers and installed by Hatzel & Buehler, electrical contractors, offers an interesting case study of a job practically unique in structure and function.

The building occupies a full city block. A basement area serves building operation utilities, maintenance and tenant storage. At street level on the 9th Avenue end is the entrance for long distance buses with roadways and loading ramps around the outer periphery of the long distance concourse. Above is the main concourse which is entered at street level on 8th Avenue. The suburban concourse on the next level provides access to 75 suburban loading platforms on the floor above. Suburban buses enter from the west over a viaduct leading directly to the Lincoln Tunnel approaches. The roof is a public parking area also reached by the viaduct.

The electrical system of the Port Authority Bus Terminal is supplied with electrical energy from two service switchboards located in the service entrance rooms. Three substations,

fed from these service switchboards, constitute load centers from which distribution is made to all parts of the building.

Remote control, visual and audible alarms, as well as indication for much of the electrical equipment is centralized on the Watch Engineer's Panel in the Watch Engineer's Office. This office also contains the master clock for the electronic clock system and the control and indicating panels for the fire and sprinkler alarm systems.

A public address system is provided primarily for paging service. It can also be used to provide music entertainment in some areas. The amplifiers are located in the amplifier room.

A dispatching system for control of the long distance buses is installed with a central control desk located in the Dispatcher's Control Booth.

The major items of mechanical equipment, such as sprinkler and fire pumps, pressure reducing valves for the steam system, hot and cold water circulating pumps, etc., are contained in two strategically located mechanical equipment rooms.

The pumping equipment and its as-

sociated motor control center for the ramp snow melting system is installed in the snow melting equipment room. This room also contains various audible and visual alarms, indicators and recorders mounted on a control panel.

Thirty-one motorstairs are provided for carrying the passengers between floors. Several elevators are also installed for movement of passengers, baggage and freight through the Terminal.

The electric power required for the Port Authority Bus Terminal is purchased from the Consolidated Edison Company at 208/120 volts, 4-wire 3-phase, 60 cycle, with grounded neutral. Service to the building (tenants included), and to the Lincoln Tunnel-Bus Terminal Connections (Viaduct), is furnished over four incoming network take-offs to two service switchboards.

Service switches are 3-pole, 250-volt, single-throw, pressure-type disconnect switches for 3-phase, 4-wire service, with a removable link in the neutral. The operating mechanism is of the dead front, rotary handle type, grounded by braided copper strap to

Frontiers for Electrical Progress . . .

. . . A Mid-Century Article





COMMUTER BUSES exit at upper level over sodium vapor lighted viaduct.



TROFFERS are four foot sections with

the steel angles comprising the switchboard framework.

Fuses are Dural Type "X" with enclosures, located just below the switch blades on the ebony asbestos switch base. Minimum interrupting capacity of all fuses is 100,000 amperes at full recovery voltage.

Feeders to Substations A, B and C from service switchboards No. 1 and No. 2 are, in whole or in part, low reactance feeder bus duct, designed to withstand mechanical stresses resulting from short circuits of 75,000 amperes. All bus bar joints are bolted, with silver-plated contact surfaces, and are enclosed in joint or cable boxes. Covers of joint and cable boxes are easily removable for inspection and maintenance. All bus bars are covered with lapped varnished cambrie sheet and tape to a thickness of $\frac{1}{2}$ inch. Bus bars are insulated from structure by ebony asbestos lumber and from each other by oil and moisture resistant fiber spacers.

Switchgear. Substations "A", "B" and "C" each contain essentially the same type of switchgear consisting of Westinghouse low voltage, indoor, metal enclosed, drawout type of air circuit breakers. Main and tie breakers are electrically operated, whereas distribution breakers are manually operated. Main and tie breakers are equipped with instantaneous short circuit trips only. Distribution feeder breakers are equipped with both overload and short circuit trips except that standpipe fire pump feeder breakers are equipped with short circuit trips only.

Each main circuit breaker is equipped with a "one-shot" automatic recloser which operates on overload tripping of the breaker. When the

breaker has tripped, it will automatically reclose after being open for 15 seconds. If the breaker remains closed for 9 seconds, the recloser automatically resets itself. If the breaker re-trips before the end of this interval, the resetting operation of the recloser is interrupted and the breaker locks itself out until the breaker is manually closed.

Electrical energy for house lighting and power is distributed through a system of distribution panels, house-lighting panels, and house power panels. Electrical energy for emergency lighting is distributed from the separate emergency system.

Watch Engineer's Control Panel. A Watch Engineer's Control Panel is installed in the Watch Engineer's Office to provide a central point at which information on the functioning of various equipment installed throughout the Bus Terminal may be obtained. Controls are also provided on the panel for controlling various motors, lighting panels, etc.

Just as the substations can be called the heart of the electrical distribution system, the Watch Engineer's Control Panel can be called the heart of the electrical control, indication and alarm system, and will be of tremendous aid in maintaining continuous and satisfactory operation of the equipment installed in the building.

The Panel is comprised of several sections, as follows:

- A. Lighting Control Panel
 - B. Pilot Light Indicating Panel
 - C. Motor Control Panel
 - D. Annunciator and Trouble Panel
 - E. Heating, Plumbing, Air-Conditioning Panel
 - F. Heating Zone Control Panel
- The Bus Detector System gives the

main dispatcher a means of controlling the flow of long haul buses from a central point. It consists of a treadle in each of the 40 bus berths on the long distance bus level, a berth number sign at each berth, a control desk in the Main Dispatcher's Booth, and an assignment sign immediately outside the Main Dispatcher's Booth.

Under normal operating conditions, when a bus enters the Terminal, the driver will see the red traffic signal on the assignment sign and stop the bus.

The dispatcher will assign the bus to a berth by pulsing up the "assign-delay" switch to the "assigned" position. When the berth has been assigned, the yellow indicating light for that particular berth will light; the red traffic light will go out; the berth number will appear on the assignment sign; one of the red neon directional signs will light and the white lamp in the berth number sign will light.

The bus then proceeds to the right or left of the assignment sign as directed by the arrow and then on to its berth. After a time delay, the berth number on the assignment sign goes out, the red traffic signal will light and the sign will be set for the next assignment.

Clock System. An electronically-synchronized system of clocks and time recorders is installed. Equipment for producing the high-frequency impulses used for synchronizing includes a master time control unit and several electronic impulse transmitters which transmit synchronizing impulses over the entire electrical distribution system. The hourly synchronizing signal is utilized by the indicating clocks and by electronic relays provided with each piece of minute impulse type equipment.



glass diffusing panels



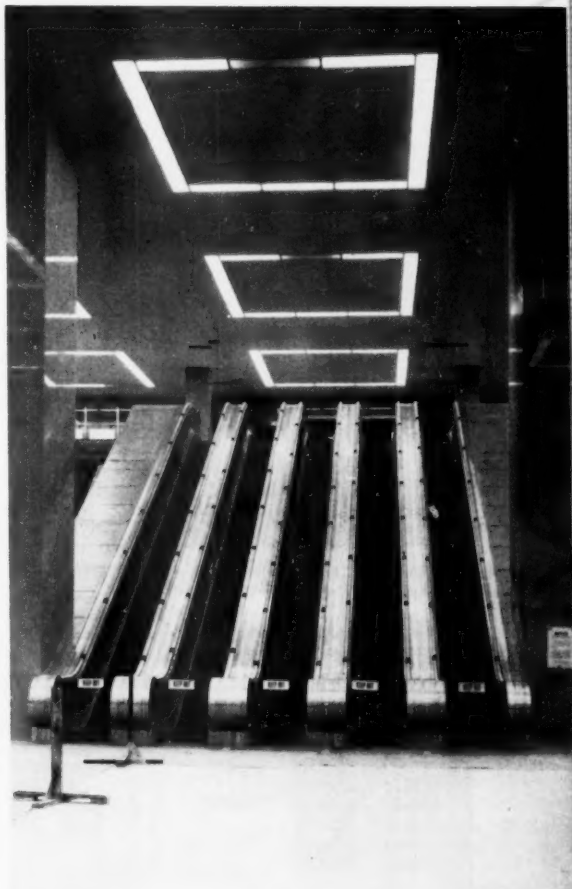
DIORAMAS, signs, counters present many complex lighting details.



ROOF is block-long parking area. Floods are 500 w. remote controlled, aided by flush units in surrounding parapet.



NEWS STANDS, stores and concessions are served from tenant circuits on metering panels.



MOTOR STAIRS move commuters between concourses and loading ramps. Green fluorescent lamps shine through step edges.

Lighting Fixtures and Controls. Both incandescent and hot-cathode fluorescent lighting are used, the type depending upon the nature of the area being lighted and the intensity of illumination desired.

Incandescent lighting is used, generally in areas subject to low temperatures or where low footcandle intensities are adequate, such as bus areas, work and storage areas, for roof floodlighting, marquee lighting and facade floodlighting. Recessed incandescent fixtures and fixtures installed in areas where they are subject to dirt and fumes are equipped with glass covers. Fluorescent lighting is used, generally, in concourse and office areas.

Lighting Control. Control of lighting throughout the building is accomplished in one of the following ways:

1. Local switch control
2. Panelboard breaker control
3. Astronomical time switch control
4. Remote control from the Watch Engineer's Board
5. Remote control from the East Penthouse

Local switching by means of wall switches is used in rooms and in areas where control of a small number of

lights is necessary. Switches accessible to the public are key operated.

Panelboard breaker control is used for "emergency" lighting circuits and other lighting which is switched "on and off" very infrequently, and lighting circuits whose panelboards are conveniently located with respect to the lighted area.

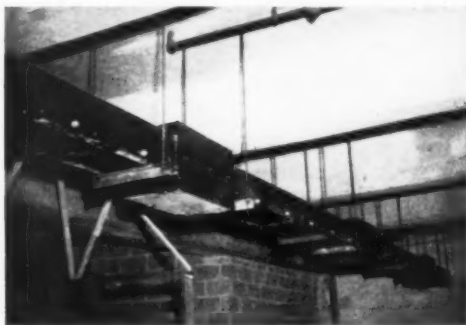
Astronomical time switch control is used for some of the lighting under the Eighth Avenue marquee and the floodlighting of Eighth Ave. facade.

Remote control from the Watch Engineer's Board is used for general lighting in the main, suburban and the long distance concourses and for the bus lanes on the long distance and suburban bus levels. The circuits are so arranged that in the main and suburban concourse and in the bus lanes lights may be turned off in a definite pattern to provide evenly distributed lower intensity lighting during off hours. In the long distance concourse, the circuits are so arranged as to permit one, two or all three lamps of each three lamp fluorescent fixture to be lighted, as required.

Intensive Lighting. At the entrances to the long distance and suburban bus

levels graduated high intensity lighting is provided by means of high bay luminaries, RLM reflectors and floodlights to effect a gradual transition from high level daylight illumination outdoors to the relatively low level lighting prevailing within the terminal. The luminaries give general high intensity illumination on the roadway while the floodlights highlight vertical surfaces, such as columns and curbs, with the object of focusing the bus driver's attention on structural elements preventing a potential hazard. The high intensity lighting is in use only during daylight hours.

Emergency Lighting. Strategically located throughout the building are individual lighting fixtures supplied from the emergency lighting panelboards. The fixtures are of the same type as other fixtures in the area and cannot be distinguished from them since they are a part of the general lighting pattern. In the event of "normal power" failure, or if the "normal" lights are switched off, the emergency lights will continue to burn and provide sufficient light to permit passage throughout the building. All exit lights are on emergency circuits.

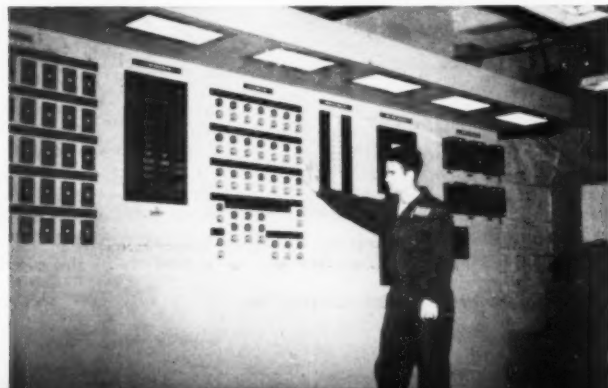


LOW REACTANCE bus feeders connect service entrance rooms with distribution substation switchboards.



SUBSTATION "B", one of three, has 1600 amp. main and tie air circuit breakers, 600 amp. distribution feeder breakers.

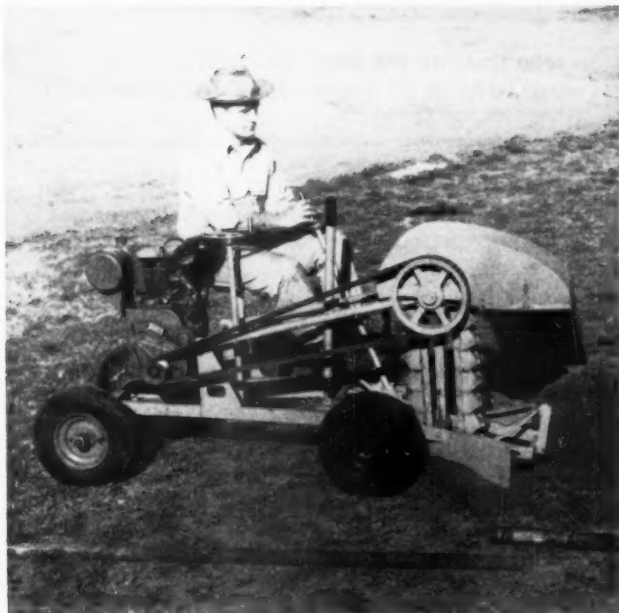
WATCH ENGINEER'S control centralizes operation of terminal for lighting, power, heat.



MAIN SERVICE switches are totally enclosed and interlocked. P. A. Engineer Wm. Henschel demonstrates operation.



Case Study In Mechanical Trenching



SMALL TRENCHER with 6 hp. engine cuts 24 inch deep conduit trench on drive-in project at 12½ percent of hand labor cost.



HOLMES ELECTRIC CO. job included 24,000 feet of trenching for wiring and utilities in a 560 by 880 foot theater area.

Cost Comparison Data

10,000 ft. 4½" x 24" trench for electric circuits and piping.

	Ft. per 8 hr. Day	Total Time	Cost Per Ft. Labor & Expense
Machine (Ditch Witch).....	800	12½ days	2½ cents
Hand Digging	50	200 days	20 cents

Job details on underground work with a 6 hp mechanical trencher discloses practical cost savings and installation advantages.

UNDERGROUND feeders, circuits and other utilities installed under the asphalt parking area of an 800 car drive-in theater gave Holmes Electric Company of Tucumcari, New Mexico, a classic time study on mechanical ditching with a new machine. The study was made on 10,000 feet of a total of 24,000 feet of trenching required for electricity, gas, water, heating, sound and driveway curbs on the project.

For a 4½ inch wide by 24 inch deep trench, one man with a 6 hp Ditch Witch handled 800 feet per day at a cost for labor and machine upkeep of 2½ cents a foot. This compares with hand digging at 20 cents per foot. The ground formation is a tight clay mixed with cleachy limestone.

The project is served by a 6900 volt line run underground from behind the screen to the basement of the projection booth where transformers, switchgear and distribution panels are located. Feeders and branch circuits include 4500 feet of No. 8 three conductor cable run underground in steel and Transite conduits.

The ditching machine is a new development of the Charles Machine Works at Perry, Oklahoma, weighs 550 lbs. and is readily transported on a small trailer or pick-up body. It is operated by one man and is highly maneuverable for short runs or work close in to buildings or foundations.

Editor's Note

The particular type of project described in this article is currently under mobilization control limitations. However, the techniques and data pertain to conservation of critical materials or manpower and are equally applicable to other types of projects.

ECONOMICS of WIRE SELECTION

By B. J. Mulvey
Commercial Engineer, General Electric Co.

Analysis of wire insulation selection on the basis of installed cost per ampere-foot supports trend to RH in 50 ampere sizes and above.

TABLE 1

CONDUIT INSTALLATION COSTS

100 ft. Run				
Conduit Size	Man hours*	Labor 3.45/hr**	Material	Total
1 1/2	6	\$20.70	\$17.10	\$37.80
2	8	27.50	22.40	49.90
3	9	31.10	32.00	63.10
4	11	38.00	43.30	81.30
5	13	44.90	52.40	97.30
6	18	62.00	71.10	133.00
8	24	82.30	113.00	195.00
10	31	106.00	156.00	262.00
12	38	131.00	212.00	343.00
14	47	162.00	252.00	413.00
16	67	231.00	390.00	621.00

*Calculations are extended to nearest dollar.

Average values taken from General Electric Publication GET-1477.

**Based on direct labor of \$2.50 per hour with 38 percent addition for insurance, overhead and profit.

TABLE 2

CABLE COST (in dollars)

Including mark-up and splicing

AWG or MCM	Conduit Size				
	TW	R	RW	RH	RHL
14	4.05*	3.88*	5	5	...
12	5.59	5.28	8	8	...
10	8.48	7.94	9	9	...
8	14	13	14	16	53
6	23	21	23	25	74
4	30	29	30	33	86
2	41	41	41	44	109
1	56	54	56	59	143
1/0	69	65	69	73	163
2/0	83	78	83	88	182
3/0	99	94	99	104	208
4/0	118	113	118	129	256
250	143	136	143	159	308
350	183	175	183	203	375
500	258	248	258	281	513
750	393	370	392	420	...
1000	513	481	513	555	...

*NOTE: Because cable prices of No. 10 to No. 14 TW and R are so close, they are carried out to the nearest cent and the balance are to the nearest dollar.

TABLE 3

REQUIRED CONDUIT SIZE for 3 Conductors (NE Code)

Size Cable	Conduit Size				
	R, RW, RH, TW	RHL	(3 C Cable)		
14	1 1/2	...			
12	1 1/2	...			
10	3/4	...			
8	3/4	1 1/4			
6	1	1 1/2			
4	1 1/4	1 1/2			
2	1 1/4	1 1/2			
1	1 1/2	2			
0	2	2			
2/0	2	2			
3/0	2	2 1/2			
4/0	2 1/2	2 1/2			
250	2 1/2	3			
350	3	3			
500	3	3 1/2			
750	3 1/2	4			
1000	4	5			

TABLE 4

TOTAL ESTIMATED INSTALLED COST (dollars)

3 cables in 100 ft. steel conduit*

Size	TW	R	RW	RH	RHL
14	44	44	45	45	...
12	45	45	48	48	...
10	61	60	61	61	...
8	68	66	68	70	140
6	90	89	90	93	179
4	116	115	116	119	193
2	129	129	129	131	216
1	161	159	161	164	286
0	210	206	210	214	308
00	225	220	225	230	329
000	241	236	241	246	415
0000	323**	318	323	334	465
250	349	343	349	365	585
350	458	450	458	478	655
500	535	525	535	559	879
750	756	734	756	784	...
1000	961	930	961	1004	...

*Labor for installing cable based on General Electric Publication GET-1477.

**Although NEC limits TW to 4/0 and smaller in conduit, costs are included for larger sizes as a matter of information.

TABLE 5

ALLOWABLE AMPERES (NE Code)

3 Conductors per Conduit
30 C Ambient

AWG or MCM	TW, R, RW		RH, RHL	
	TW, R, RW	RH, RHL		
14	15	15		
12	20	20		
10	30	30		
8	40	45		
6	55	65		
4	70	85		
2	95	115		
1	110	130		
1/0	125	150		
2/0	145	175		
3/0	165	200		
4/0	195	230		
250	215	255		
350	260	310		
500	320	380		
750	400	475		
1000	455	545		

TABLE 6

INSTALLED COST CABLE AND CONDUIT

Dollars per Ampere per 100 ft. run 3 Conductors

AWG	TW	R	RW	RH	RW/RH	RHL
14	2.94	2.93	3.00	3.00	3.00	...
12	2.25	2.25	2.38	2.38	2.38	...
10	2.04	2.01	2.04	2.05	2.05	...
8	1.69	1.65	1.69	1.56	1.76	3.13
6	1.64	1.61	1.64	1.43	1.69	2.75
4	1.66	1.64	1.67	1.40	1.70	2.26
2	1.36	1.37	1.37	1.15	1.39	1.88
1	1.46	1.44	1.46	1.26	1.49	2.21
0	1.69	1.65	1.69	1.43	1.70	2.05
2/0	1.55	1.51	1.55	1.33	1.60	1.88
3/0	1.46	1.44	1.46	1.24	1.50	2.08
4/0	1.65	1.63	1.65	1.45	1.71	2.03
250	1.63	1.59	1.63	1.44	1.70	2.29
350	1.76	1.73	1.76	1.54	1.84	2.13
500	1.68	1.64	1.68	1.48	1.75	2.31
750	1.89	1.84	1.89	1.65	1.96	...
1000	2.11	2.04	2.11	1.85	2.21	...

The column marked RH/RW is for a dual marked cable used as RW, but priced as RH.

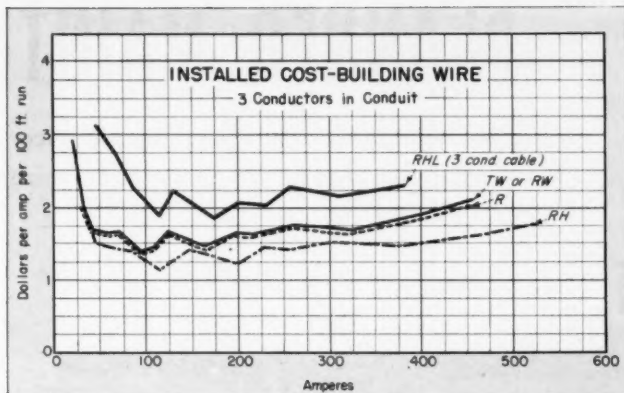
TABLE 7
INSTALLED COST

100 feet—3 single cables in conduit

Amperes	Type R	Type TW	Type RH
15	\$44.00	\$44.00	\$45.00
20	45.00	45.00	45.00
30	60.00	61.00	61.00
50	89.00	90.00	93.00
60	115.00	116.00	93.00
100	159.00	161.00	131.00
200	343.00	349.00	246.00
400	734.00	756.00	625.00

* Based on estimate of \$1.56 per amperes for 600 MCM Type RH.

Table 7 shows data from Table 4 tabulated to show costs on the basis of commonly used branch circuit and feeder load current ratings.



In the installation of building wire, there is a decided trend away from the use of Type R and toward the use of Types TW and RH. The trend to RH is particularly noticeable on circuits which are noticed to carry 50 amperes or more, while for smaller sizes, TW is increasingly popular.

It is the purpose of this article to examine the economics of the problem to show how the trend is economically justified and why it should be encouraged in the interests of lower costs and sound engineering.

RH over 50 amp.

Recent studies summarized here show that the choice of RH is more than justified for currents above 50 amperes. This is because the 75 C copper rating of RH, as compared to the 60 C rating of Type R, allows higher currents for the same copper sizes; conversely, for a given current, smaller copper and conduit sizes can be used. The overall saving in installed cost can amount to as much as 20 percent, depending on the number of amperes required.

Under 50 amp.

For sizes smaller than No. 8 Awg, the National Electrical Code rates Types R, TW, and RH at the same current. At first glance, this would appear to indicate that in these sizes, the cost differential favors Type R. However, because the greatest portion of the installed cost is in conduit and fittings, the total cost difference is very small. In the opinion of many experts, the very small difference in installed cost is more than offset by the assurance of insulation of much higher quality when RH is specified. Where moisture resistance is required, of course,

Type R cannot be used. The choice then becomes RW or TW.

One point to be borne in mind regarding the choice of moisture resistant insulations is that in many industrial applications the presence of water also means the presence of alkalis or acids. Here, because of its excellent chemical resistance, TW would be an almost automatic choice for such applications.

Actual cost figures are cited to emphasize the conclusions indicated above.

Recently, an economic study was made by the author to determine actual installed costs of the several types of building wires of one manufacturer. The cables covered were Types R, RW, RH, RHL, and TW. The material and labor costs cited were those in effect in March 1950; but, it should be noted that the relative cost of one type as compared to another has changed only slightly regardless of fluctuations in actual labor and material costs.

The study was made for currents up to about 500 amperes. All current ratings are based on the National Electrical Code.

Conduit material and cable costs are approximately those currently in effect. Cable costs are based on minimum lengths sufficient to obtain price advantage of \$500 orders. Cable costs are marked up by 10 percent to cover splicing costs. In addition, all materials are marked up to 10 percent for handling. All freight is based on delivery to the Midwest.

Conduit Installed Cost

Table 1 shows the cost of a typical 100-foot run of conduit installed. The cost includes couplings, elbows, hangers, et cetera. The labor values

assigned are based on estimates from three or four different sources.

Cable Installed Cost

Table 4 gives the estimated installed cost for three conductors in 100 feet of conduit for sizes between 14 Awg and 1000 MCM. Table 6 and Curve 1 give the installed cost in dollars per ampere per 100 foot run for the various sizes. The points on the curve are for NEC ratings. Capitalized power losses are not included. The cables are chosen on the basis of current carrying capacity; it was deemed impracticable to factor voltage drop into the charts, although it should always be considered in a specific case.

Conclusions

In examining the data summarized in Curve 1, it is interesting to note the flattening of the various curves for currents between 50 and 400.

For quick estimating in that range, one could use the following tabulation:

Cable	Dollars per Amp per 100 Ft. in conduit
R, RW, or TW.....	1.62
RH	1.44
RHL (lead covered)...	2.19

For currents below 40, that is, for sizes 10 to 14, it makes little difference cost-wise which type of non-leaded rubber-like insulation is used. However, the possible presence of moisture, acids, alkalis, and ease of handling, et cetera, have evidently influenced a great many users in favor of TW. Note, however, the large cost advantage in RH for sizes larger than 10 Awg.

PLANNED MAINTENANCE

The importance of electrical maintenance, how to survey and analyze the need for it, and how to organize and provide for it.

TODAY, there is some electrical equipment in every plant, regardless of size. Maintenance of such equipment becomes a matter of paramount and constant importance from the date of installation.

In every plant there is always someone who is familiar with the problem of maintenance of main equipment on which operation of the plant is based, like printing presses in a printing establishment, rolling presses in steel mills, etc. People who run these businesses are more likely to know all about such machines than they do about associated electrical equipment. Among the mechanics and workers there can always be found those who are also familiar with the upkeep of a plant's basic machinery.

Electrical equipment usually comes as a part of main machinery, with its value hidden in the overall cost of the machinery. Thus, its investment value is not evident, and the importance of keeping such equipment in ship shape condition is sometimes overlooked. Although electrical equipment is in a sense auxiliary, its failure stops machines and on its operation depends the continuous operation of the plant.

Need for Maintenance

Table I shows the relative value of electrical equipment in different categories of horsepower. It can be seen that, for example, in the range from $7\frac{1}{2}$ to 15 horsepower, the average cost of a dc motor with magnetic control is about \$954.00. If a plant has ten motors falling into this category it will represent an investment in electrical equipment equivalent to \$9,540.00. This is high enough to justify proper protection, through establishment of preventive maintenance, to keep it in very good running shape. In addition electrical equipment, nowadays, is not always immediately available. Repairs, of course, are possible. But they represent additional expense, and the cost of repairs varies roughly from 60% of the cost of new equipment in small fractional motor sizes to 40% in large integral horsepower units. Consider the cost of electrical equipment, and

By Walter J. Prise

*Director of Industrial Service
The Maintenance Company, Inc.
New York City*

the cost of repairs, together with dependence of production schedules on operation of motors and controls, and the question of preventive maintenance of all electrical equipment becomes more important.

Maintenance of electrical equipment presents many special problems which require special attention. The program for maintenance of electrical equipment should be part and parcel of the overall maintenance program of a plant or factory. But, due to peculiar characteristics, it is often considered as a separate part or unit with different rules to follow and procedures to observe. This article shows, without technical details how a general electrical maintenance plan can be made to suit a particular plant, and how to describe special problems and point ways for their solution.

Electrical power equipment in most plants consists of three major groups:

First group—Power sub-station, wiring and associated apparatus, such as circuit breakers, switchboards, etc.

Second group—Rotating machinery; motors, generators, M-G sets, rotary converters, frequency changers and others.

Third group—Special equipment, electronic devices, rectifiers, neutralizers and like.

These three components present different problems and different situations to handle with most of the problems concentrating in Group 2, due to presence of moving parts and other potential trouble producing devices.

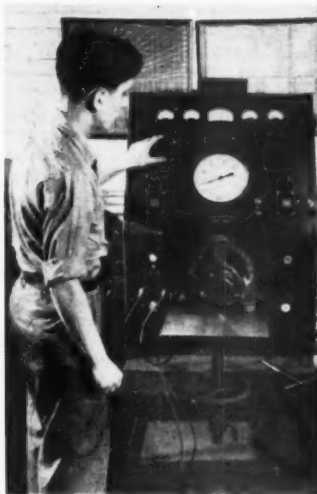
An electrical maintenance department, as a part of the plant engineering department, is required to determine when electrical machinery and apparatus has become obsolete and replacement is necessary. Likewise, it has to introduce new equipment which may reduce cost of production. With aging of equipment and its obso-

lescence, the cost of operation goes up. Efficiency is lowered. Reliability is diminished, and cost, plus possibility of repairs, is increased. Insulation becomes brittle and breakdowns are very likely to occur, and equipment may reach a state where replacement is advisable, and quite possibly the best solution. Sometimes, repairs can not be made quickly due to lack of spare parts, or to their complete unavailability. For instance, an old switchboard with exposed wiring and current carrying parts may create serious fire and personal injury hazards. Low voltage lines which are too long can cause high voltage drop, and consequently high losses. Old starters have no modern protective devices. Some distribution systems may be so arranged that flexibility is small and trouble in one spot will put a large number of machines out of order. Distribution systems may have no spare capacity and additional new machines may require expensive wiring jobs. Some of these factors can be easily corrected before they cause serious troubles. Misapplication of equipment, such as use of open type motors in hazardous locations, almost invariably spells trouble and expense.

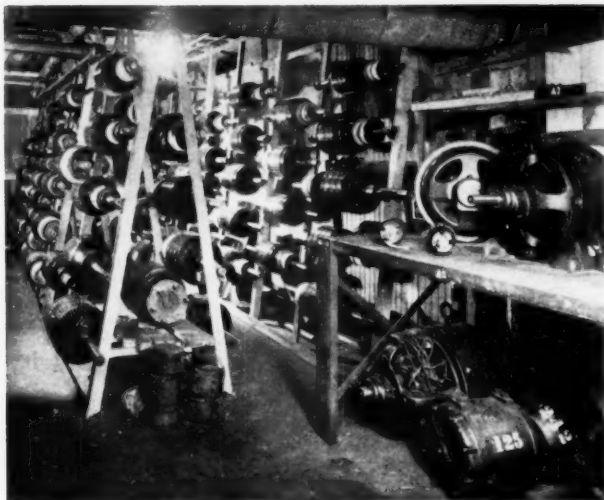
Poorly maintained electrical apparatus, in addition to being a cause of repairs, is quite often a source of injury to operating personnel. Equipment kept in good shape is good insurance against accidents and loss of life.

Maintenance Program

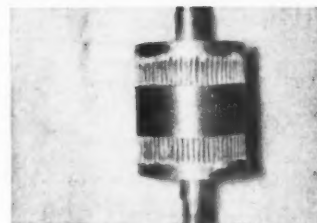
A good maintenance plan takes care of everything needed for successful operation, and nothing else. Establishment and adoption of a good maintenance program can only be arrived at after a careful analysis and survey of existing conditions. This analysis must be performed by a group of individuals, who by training and experience, are capable of determining what is essential in the maintenance of electrical equipment of the plant. These individuals must combine a knowledge of electric maintenance methods with an understanding of the overall prob-



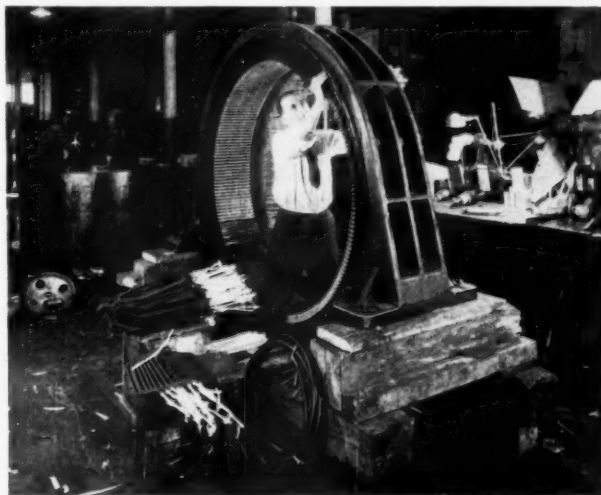
COMPLETE TESTING FACILITIES assure quality work in the modern repair shop.



SPARE PARTS STOCK is essential to rapid repair work and prevention of long and costly shutdowns.



DAMAGED ROTOR (upper) resulted from overheating. Prompt repair put rotor in first class condition (lower).



FOREKNOWLEDGE through accurate records of complete winding data and insulation requirements of the installation insures as good as or better life expectancy of the rewind. It also increases efficiency and lowers costs.

lems of the plant. It must be borne in mind that a too elaborate or expensive plan may ruin the feasibility of its adoption, since expense of maintenance may exceed anticipated savings.

A survey may show that some equipment has become too obsolete to be of value, and that continuous repairs will disrupt the maintenance budget and justify replacement. Before a plan is permanently installed a test period may

be necessary to discover hidden flaws and introduce corrective measures before it goes too far.

From a technical angle, the plan must give detailed instructions to cover handling of routine work and provide recommendations for certain types of work. These recommendations must be based on knowledge of such technical subjects as general characteristics of dc and ac machines,

of the electrical code covering the territory in which the plant is located, of control apparatus and its characteristics, of lubrication, commutation, selection and application of bearings, of knowledge of electric insulating and conducting materials, trouble shooting in electrical machinery, proper use of instruments and many other problems involved in development of measures essential in preventive maintenance.

To keep a system in operation a set of records and procedures must be established. Records should include: work orders, maintenance recommendations, maintenance records, inspectors reports, equipment performance record, repair records, and other necessary records. Records must be simple, show troubles developed in equipment and steps taken for corrections and adherence of mechanics to "doctor's" prescriptions. Good records of this type will also furnish valuable data for evaluation and rating of working personnel by showing performance of individuals. Records must be adapted to overall systems and methods used by the company and should, as much as possible, minimize the need for extra clerical help. If possible, they must reduce certain existing red tape and procedures. Records should provide an easy check on maintenance program costs and every possible elimination of office work and paper red tape. Progress made from year to year, or drawbacks experienced, must also be clearly shown on these records. From time to time all records must be analyzed and only

those which are simple, clear and instructive justify their existence in operation—others should be abolished. Eliminate all forms that make clerks of expensive craftsmen.

Departmental Operation

An electrical maintenance department should have very definite responsibilities and duties, and well defined relations with other maintenance groups; also, with production, engineering, cost accounting, and other departments. A clear and easy-to-understand code of authority must be drawn for all maintenance department personnel to eliminate friction, misunderstandings and other similar "luxuries" which cannot be tolerated in effective and expedient operations. A good balance of senior and junior men should be maintained, not only with the idea of reducing labor costs, but also to insure full utilization of the talents of highly trained men. Skilled men should not be wasted on minor jobs. A good balance also assures replacement and provides junior grade men for possible expansion and growth.

The prime duty of maintenance is to keep equipment in production without interruption of service, failures or accidents. A repair department completely capable of performing needed repairs may be kept in operation either as an independent unit, or as a part of the general maintenance department of a plant. The latter plan is, in general, preferable. One head of these two functions eliminates possibility of "passing the buck" and shifting responsibility.

A squad of experienced and efficient trouble shooters must be maintained, and should be a very important part of the department.

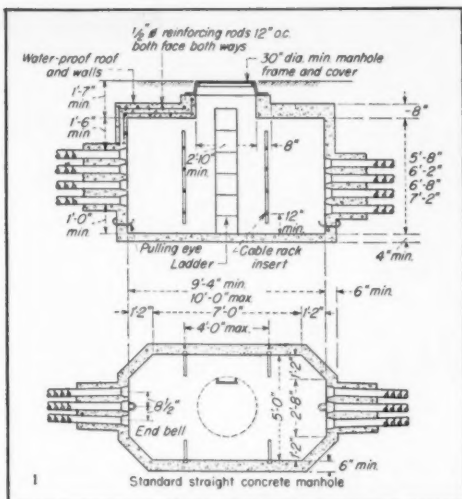
As a general rule, routine maintenance men are poor trouble shooters, and those who possess the ability to do trouble shooting are not capable of performing routine types of jobs. Figuratively speaking in terms of men, it is important not to put a round peg in a square hole.

All rules and regulations of the department must be carefully planned and justify their existence, and then be rigidly enforced. Supervisory

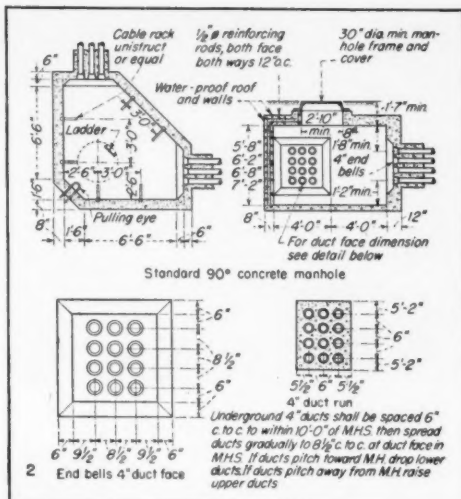
[Continued on page 170]

Table I—Cost of Electrical Equipment

H. P.	MOTORS				CONTROL				LEGEND
	1 ϕ		3 ϕ	D. C.	1 ϕ		3 ϕ	D. C.	
	RSI	Cap	S. C.	Shunt	Man.	Mag.	Man.	Mag.	
$\frac{1}{8}$ – $\frac{1}{2}$	48.12	27.66	38.23	53.63	9.12		9.12		<p>All prices listed represent rough averages, should be used for reference only.</p> <p>Motors listed are 220 v. open general purpose horizontal type, 1800 RPM. Controls listed are general purpose, non-reversing starters.</p>
$\frac{3}{4}$ – $1\frac{1}{2}$	139.70	64.90	73.43	145.20	9.12	44.22	30.00	43.55	
2–5	286.00		115.50	288.00	33.50	50.00	32.67	54.45	
$7\frac{1}{2}$ –15			221.00	583.00			409.20	689.00	
20–40			456.50	962.50			512.82	1116.82	
50–75			880.00	2000.00			805.20	2312.00	
100			1672.00				1191.00	2874.00	
↓									
150				3300.00					
								2588.50	



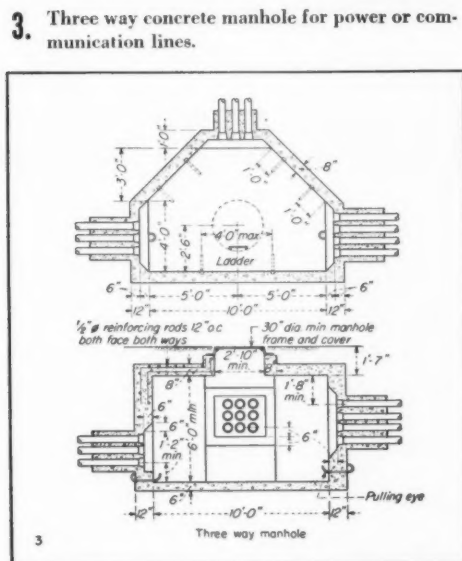
1. Straight through concrete manhole for power or communication lines.



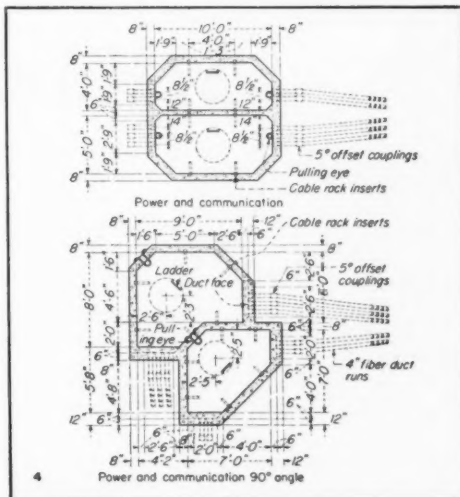
2. Right angle concrete manhole for power or communication lines with duct spacing details.

Electrical Design Details*

Manhole details for underground power and communication distribution systems.



3. Three way concrete manhole for power or communication lines.



4. Straight through and right angle combination manholes for power and communication lines.

* By Wallace M. Adache, Adache & Case, Engineers, Cleveland, Ohio. Drawing copyright by author and used by permission. Articles are selected

abstracts from the manuscript of a forthcoming book on electrical construction design standards.



POWER COUPLING of conduit is used by make-up crew. Truck has threading machine power unit with generator trailer to operate it.



TEMPLATES POSITION mounting bolts before pole bases are poured.

Mobile power equipment, crew specialization and modern methods cut installation time to minimum on large community street lighting project.



REEL TRAILER carries cable to feed-in point; can hold one or two cable reels.

STREAMLINING A STREET

IT'S going to take 5,000 lighting standards to illuminate the 133 miles of streets weaving around Lakewood Park—the 3,400-acre, 17,000 unit (single-family home) housing development near Long Beach, California. To Kuster-Wetzel Electric Company in Long Beach, this project (handled separately from the house-wiring contract) was a challenge to the ingenuity and know-how of its engineering and supervisory staff. To pace the rapid progress of the general contractors, K-W organized specialized field crews; adapted production-line and pre-assembly techniques; made maximum use of power equipment and new installation methods. Result: a streamlined operation

with substantial man-hour economy.

The lighting system is the conventional 2,300-volt, 6.6-amp. series type with 10,000-lumen lamps on single-arm, Marbelite standards. Underground circuits of No. 8 cable in 1-inch conduit tie the standards together. Units are mounted on both sides of the street in a staggered pattern (approximately 300 circuit-feet between standards). Constant-current transformers are generally located in buried housings near the standard base.

A pre-arranged installation sequence dovetails with the general contractors' activities. Immediately after the concrete curbing is set, the conduit circuits are installed and stand-

ard bases poured. When the black-top streets are laid and grading between curb and sidewalks completed, the cable is pulled and finally the standards mounted.

Power equipment and production-line methods combine to substantially speed circuit installation. A K-W truck load of conduit cruises up and down the streets dropping off lengths of 1-inch conduit end-to-end between excavations for standards. Following in its wake comes a "make-up" crew of two mechanics with a truck carrying the electric power unit of a threading machine and pulling a gaso-line generator trailer.

After the truck is stopped at an excavation, a length of conduit is



BASES ARE POURED in a few minutes by transit-mix truck moving down the street.



COMPRESSED AIR cleans out conduits; blows fish line through 300-foot run in a few seconds. Specially designed coupling does the trick.



STANDARDS ARE ALIGNED with aid of plumb-bob instrument.



WINCH TRAILER is spotted at base for double pull; has shaft extension to center "cats-head" over conduits. Second pull is made with simple reversal

LIGHTING PROJECT

By James S. Kuster
Kuster-Wetzel Electric Company
Long Beach, California

fastened in the power unit chuck and the switch turned on. As this conduit slowly revolves, the mechanics work their way back 300 feet to the other excavation, coupling the conduit as they go along. The first three lengths are tightened with a wrench; all others (except last length) are tightened by hand. A wrench on the last length provides the final "take-up" on the 300-ft run. All threads are painted before coupling. Sweep ells are then bent on the ends of the run and the conduit "kicked" into a shallow trench behind the curbing. This process is repeated all along the line. Normally, the team can complete a 300-foot run in about 15 minutes; can complete better than 6,000 feet of conduit in a

day if no complications are encountered.

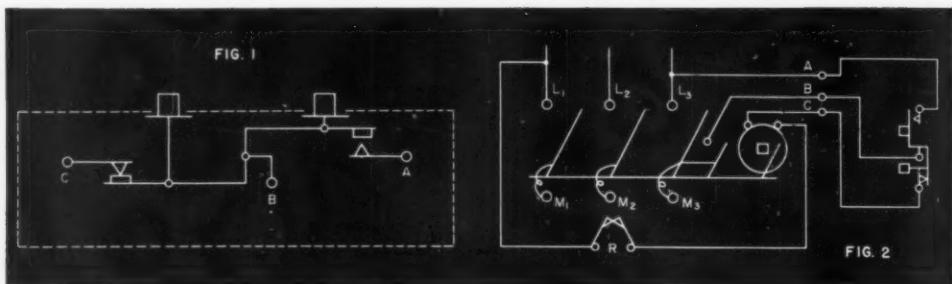
Next in line is the "template" crew who set the mounting bolts for the light standard, align the conduit stubs and install the grounding jumpers. Steel plate templates are held securely in place by stout wood brackets resting on the curb and fill. Concrete bases are poured in a few minutes by transit-mix trucks as they move along.

When the bases have hardened, the cable crew takes over. Three trucks with three pieces of mobile equipment are used in this operation. First in action is the "snaking" truck with its air compressor trailer. Through a special Y-coupling designed by K-W engineers, compressed air is blown

through the conduit. One or two "shots" are used to blow a rag through to swab out the conduit line. A second shot blows a line through the 300-ft. run in a few seconds. A $\frac{1}{4}$ -inch rope with a rag through an end-loop is used. The coupling is quickly transferred to the second conduit stub and another line is blown through.

While other lines are being blown in, the cable crew gets busy with its reel and gasoline winch trailers. The winch is dropped at a base for a double pull; has a shaft extension which centers the "cats-head" over the conduit stubs. When one pull is completed, the winch operator merely reverses his hitch on the cats-head and

(Continued on page 172)



Remote Control Circuit Safety

FINE points in control circuiting and maintenance, often overlooked because they are not covered by codes, can make the difference between a safe control and one with hidden hazards for the operator.

This article is written to cover hazards in industrial remote control circuits and to point out features of wiring design which can prevent accidents by failure of such equipment. Within a seven year period, two men were ground up in electrically driven concrete mixers because they depended on control circuits, and these circuits are becoming more extensive and complicated each year.

The most common hazard results from improperly connecting a string of pushbutton stations in series, for operation of one motor. Fig. 1 shows the schematic diagram for a simple type of pushbutton station which some manufacturers furnish with their magnetic motor starters. The normally-open contacts at Terminal A are for the start-button and the normally-closed contacts at Terminal C are for the stop-button.

The two pushbutton arms are hinged together at the center, with Terminal B common to both, so that there is no way of using more than three terminals. Three terminals are satisfactory, when only one pushbutton station is to be used, but stations having separated action and four terminals must be used for series connection of more than one.

Fig. 2 (a schematic) shows the connection of the station (of Fig. 1) to the earliest form of magnetic starter. The sloping lines represent, from left to

right, the three contact arms for motor leads, the auxiliary contactor for the hold-in circuit, and the armature of the hold-in coil; all being mounted on one shaft. R represents the running-over-current protective relay, inserted in the control circuit.

By tracing the connections of Fig. 2, it is apparent that one cannot obtain any action by closing the start-button, if the stop-button is held open. This is not true, however, in Fig. 3, where more than one three-terminal stations are being used. It will be seen that a start-button, near to the starter, can inch the motor along in spite of the fact that a stop-button is held open at a station farther away from the starter. This presents a serious hazard; and especially so when lock-out type stop-buttons are depended on to render equipment inoperable.

Pushbutton Stations

Figs. 4 and 5 show proper methods of connecting a series of pushbutton stations. The top row of buttons are the start-buttons and the bottom row are the stop-buttons. From these schematics the necessity for four-terminal stations is apparent, and tracing through the circuit reveals that there is no way of by-passing any open stop-button, other than a short-circuit within the control circuit wiring.

This brings us to another hazard presented by a grounded phase wire of a Delta-fed system. Some states require grounding of all 230 volt, three phase systems. In a three phase Wye-connected secondary of a transformer bank, the common tie point can be grounded. But a straight three

phase Delta has to be grounded on one corner or phase wire, unless one of the transformers has a center tap.

When an electrician goes into a strange plant to work on control circuits he should test the three phases to learn if one is normally grounded. If there is a grounded phase it must always be connected, at motor starters, to the line terminal from which one side of the hold-in coil is fed.

For connections as shown in Figs. 4 or 5, the grounded line wire must be connected to the L_1 terminal. Various manufacturers' starters will differ in their connections but it is a simple matter to trace them out and determine which line terminal is used to feed one side of the hold-in coil without passing through any pushbutton station.

Studying Figs. 4 and 5, one sees that any fault ground within the control circuit connections will by-pass the hold-in coil if the grounded phase is connected to L_1 . But if the grounded wire is connected to L_2 or L_3 , a fault ground may energize the hold-in coil and start the motor.

With a Wye-connected secondary of a transformer bank and the common tie point grounded, we have a different set of conditions. There is no way to connect the starter or control circuit which will prevent a possibility of fault current flowing through the hold-in coil, in the event of a fault ground in the stop-button circuit. However, the voltage to ground, in such a case, is so much less than the phase-to-phase voltage that the hold-in coil should not pull in unless the voltage regulation of the supply is very poor.

It would be well to test this feature

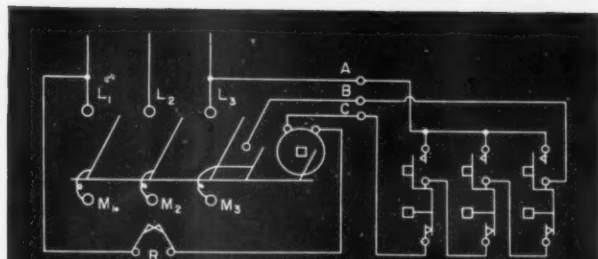


FIG. 3

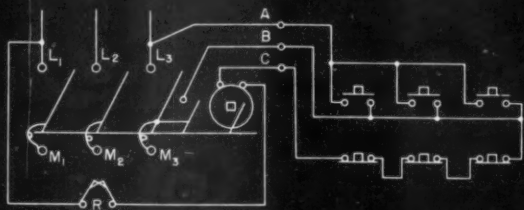


FIG. 4

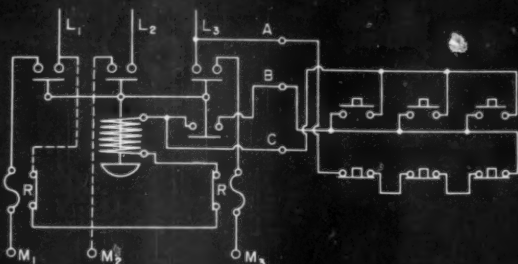


FIG. 5

on old style starters by introducing a fault ground at the terminal of the coil which is normally connected to the pushbutton stations. The characteristics of these old coils were not computed so closely, in the early days of magnetic starters. You didn't have to crowd whole rows of them into a miserly space and there were shafts and bearings to acquire friction. Coils were given ample turns to correct for voltage drops and overcome friction of mechanisms clogged with dust.

If an old magnetic is found to pull in on a fault ground with a Wye-connected transformer supply, it should be used for some motor which would present no hazard if accidentally started, such as a centrifugal pump.

In rural areas, it is common practice to furnish commercial or industrial consumers with a three-phase, four-wire service from an open or a closed-Delta transformer bank; deriving a grounded neutral from a center tap of one transformer of the bank. Thus, the two phase wires of the center tapped transformer have a voltage to ground of around 115 volts, while the third phase wire from the bank runs about 185 to 190 volts to ground.

This third phase wire is often called the "high leg" or the "wild phase," by electricians. When connecting three-phase supply from such a system to a magnetic starter, the high leg must not be connected to either of the terminals from which the control circuit

Connection details of controls to insure reliability of operation and safety to the machine operator.

By Thos. R. Hughes

*Electrical Safety Engineer
State of California
Division of Industrial Safety
Los Angeles, Calif.*

wiring is energized. In Figs. 4 and 5, the high leg must be connected to L₁ terminal. If it becomes necessary to reverse the line wire connections to secure correct rotation of the motor, L₁ and L₃ must be the pair that are changed.

The reason for these precautions is the same as that for the other grounded systems: to keep the higher voltage-to-ground from being accidentally conducted throughout the hold-in coil if a fault ground appears in the control circuit wiring.

Conduit

All of these considerations are predicted on the supposition that the control circuit is completely enclosed in conduit or other approved metal raceway. However, there is increasing use of pushbutton stations at the end of multi-conductor portable cable extensions, where the operator must move about to observe conditions and yet retain constant control.

Electrical codes state that separate fusing of control circuit wiring will not be required. However, if the line fuses ahead of the starter are large, and a portable cable is used in the control circuit, any damage and consequent short-circuiting of the cable can cause the destruction of fine parts in the running overcurrent relay before a control circuit wire burns free. It is a wise move to insert a separate fused switch with small fuses, such as three or six ampere, in the control circuit. Much less time will be lost than would be if one had to run all over the plant to find where a similar relay could be borrowed to replace the damaged one.



BUS DUCT mounted in web of beam (arrow) distributes 480-volt power to individual machines in manufacturing areas. Lighting installation was simplified by mounting to channel spanning bay.



STORAGE AREAS in center of plant are lighted by incandescent units, can be quickly changed to production areas when fluorescent fixtures would be substituted. Ventilation units are on roof truss platforms. Fork lift trucks service area.



CONTRACTOR SAVED valuable time by using plastic insulating tape on conductor connections both inside and outside the plant.

DISTRIBUTION economy and flexibility plus service continuity keynote the electrical system design at the new 13-acre plant of the A. B. Dick Company near Chicago. From the 33-kv. outdoor substation through the secondary circuits possibilities of future expansion and production changes were carefully considered.

Two separate 33-kv. overhead utility circuits feed the outdoor substation which has an ultimate capacity of 10,000 kva. (present plant capacity approximately 5,000 kva.). From this point, a 4,160-volt, 3-phase primary loop feeder enters the plant through underground fibre conduits. A bus tie in the primary metalclad switchgear can be used in an emergency. Spare underground conduits provide available raceways for pulling in another set of conductors should service feeders fail.

To economize on copper and reduce power losses to a minimum, 4,160-volt primary radial feeders originate at air circuit breakers in the switchgear and distribute power to one double-ended and six single-ended unit substations located at load concentrations throughout the plant. Feeders consist of neoprene jacketed conductors in overhead conduits. Substations, in most cases, are located over plant washrooms to conserve floor space; range from 500-kva. to 1,500-kva. in capacity.

Service continuity is assured through secondary ties between the six 4,160/480-volt, 3-phase unit substations in the manufacturing area. Should a primary feeder or substation transformer fail, load on the affected unit (up to 50 percent capacity) can be quickly transferred, by means of the secondary ties, to another substation. The only unit not so interconnected

MAXIMUM

Production efficiency, through flexible electrical system, high level lighting, atmospheric control and materials handling, is feature of new Austin built plant of the A. B. Dick Company in Niles, Illinois. Electrical facilities were installed by Electrical Contractors, Inc.; and Henry Newgard & Co.

is the 4,160/120/208-volt, 3-phase, 4-wire substation in the office building.

Secondary 480-volt power is carried throughout the manufacturing area by 400-ampere, 3-phase bus duct cir-

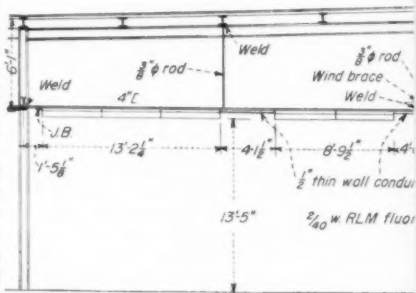


FIG. 1—Mounting details of fluorescent fixtures in manufacturing areas. Note how 4-in. channel spanning bay requires



TABULATING MACHINE room has 60 footcandles of illumination provided by 2-lamp, recessed continuous fluorescent units with aluminum reflectors and eggcrate louvers. Glass partitions simplify noise and air control problems.



CONTINUOUS FLUORESCENT cove and flush-type incandescent units with diffusing lenses illuminate the 284-person cafeteria. Concealed spots highlight food on counters. Mixing of light sources improves color quality of light.

CAPACITY in MINIMUM SPACE

cuits with conduit drops to individual machines. With the exception of the solvent building, where power and lighting systems are explosion-proof, electrical equipment is of the standard type.

Plant lighting operates on 120/208-volt, 3-phase, 4-wire systems originating at 22 dry-type, air-cooled transformers strategically located on roof-truss mountings throughout the area. These units, ranging from 25 to 100-kva. in size, are fed directly from the unit substations; serve column-type lighting distribution panels; assure continuous lighting even though a secondary power circuit should fail.

Two light sources are used in the plant area. In the production departments which rim the perimeter of the

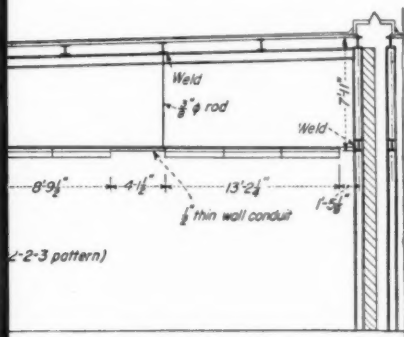
building, some 7½ miles of RLM type fluorescent fixtures (2 40-w lamps) provide general illumination ranging from 30 to 60 footcandles depending upon the seeing task at hand. Units are mounted in continuous rows 13-ft., 5-in. above the floor level in a 3-2-2-3 pattern (see Fig. 1). To eliminate a maze of supports and conduit drops, and leave roof areas free for other ducts and pipes, fixtures were mounted to a 4-inch steel channel which spans the 60-foot bay.

Additional material economies were realized by using transformers where individual lights were needed on remotely located machine tools. Instead of dropping a lighting circuit to the machine, a 100-watt transformer unit (single-phase, 440/110-volt) with a

built-in "twist-lock"; grounded, receptacle was inserted in the power conduit drop.

Incandescent RLM type units (300-watt) on 15-ft. centers provide 15 footcandles of general illumination in the central areas of the building. While these sections are now being used for storage purposes, they might be transformed into production departments in the future. Circuit design permits replacement of the incandescent units with fluorescent fixtures without any change in the wiring.

All plant lighting is controlled by panel switches. The narrow column-type is standard equipment even when located on the building walls. Here the panels and their riser troughs are (Continued on page 168)



only three suspension rods; also the 3-2-2-3 pattern of fixture spacing on the continuous rows.

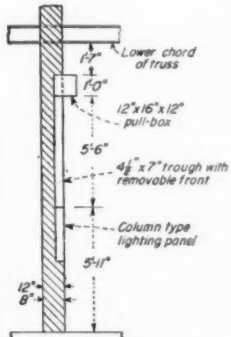


FIG. 2—Flush installation of narrow column-type lighting panels in the building walls.

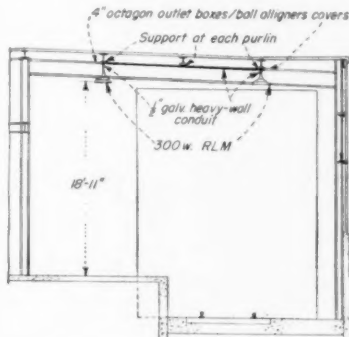


FIG. 3—Typical method of installing incandescent lighting fixtures in the receiving, shipping and storage departments.

FOR Hard-to-Start Jobs

Requiring Low Starting Current

SPECIFY

Century

TYPE RS*

MOTORS



* Single Phase, Repulsion Start, Induction, Brush Lifting Motors

Century Electric Company is celebrating its 50th year in the electrical industry.

Century SERVICE

Is Near Any CENTURY Motor Driven Equipment

Satisfactory performance of CENTURY products is assured by more than 200 CENTURY Authorized Service Stations supervised by 28 CENTURY Sales Offices.

1. Facilities for immediate exchange of most CENTURY standard ratings of standard construction are available at CENTURY Authorized Service Stations.
2. CENTURY Authorized Service Stations are qualified and equipped to service and repair any piece of CENTURY apparatus.
3. Genuine CENTURY renewal parts are available at CENTURY Service Stations, CENTURY Parts Distributors and at the factory in St. Louis.

You will find that these rugged, dependable motors meet the starting, accelerating and running characteristics of such equipment as refrigeration compressors, air compressors, stokers, reciprocating pumps, and other hard-to-start loads.

For more than 47 years, Century Type RS motors have given satisfactory service throughout the world. They are available in sizes from $\frac{1}{2}$ to 20 horsepower, in drip proof and splash proof frames.

In addition, Century builds electric motors in a wide range of types and kinds—in sizes from $\frac{1}{6}$ to 400 horsepower for operation on single and polyphase and direct current. Specify Century motors for all your electric power requirements.



CENTURY ELECTRIC COMPANY

1806 Pine St., St. Louis 3, Missouri
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ALTERNATING CURRENT MOTORS POLYPHASE

Squirrel Cage Induction— $\frac{1}{6}$ to 400 H.P.
Wound Rotor Motors—1 to 400 H.P.
Synchronous Motors—20 to 250 H.P.

SINGLE PHASE

Split Phase Induction— $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{3}$ H.P.
Capacitor— $\frac{1}{6}$ to 20 H.P.
Repulsion Start, Brush Lifting, Induction— $\frac{1}{2}$ to 20 H.P.

DIRECT CURRENT MOTORS

$\frac{1}{6}$ to 300 H.P.

GENERATORS

AC, 63 to 250 KVA
DC, 75 to 200 KW

GEAR MOTORS

$\frac{1}{8}$ to $1\frac{1}{2}$ H.P.

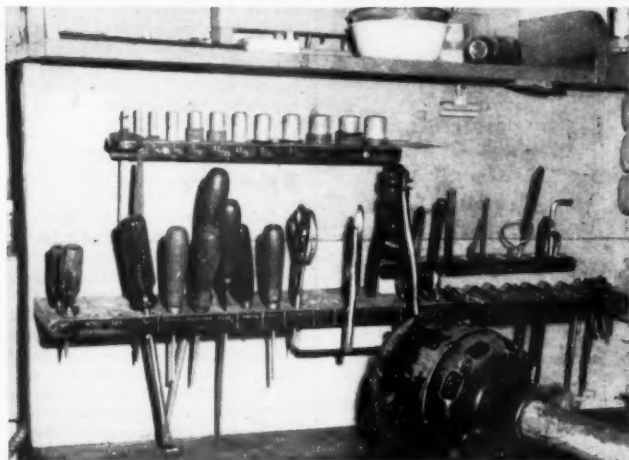
MOTOR GENERATOR SETS

AC to DC, AC to AC
DC to DC, DC to AC

Open Protected, Splash Proof, Totally Enclosed
Fan Cooled, Explosion Proof.

Ball Bearing motors are factory lubricated for several years' normal service. Bearing housing construction permits easy re-lubrication when unusual service demands it.

Motor Shops



LETTERED TOOL RACKS over each work bench and numbers on tool handles corresponding to the various bench locations eliminate confusion and prevent losses.

Numbered Tools Prevent Losses

To insure that a full set of tools remains at each work bench in the shop of the Central Electric Company of Cambridge, Massachusetts, each tool is stamped with a number corresponding to one of the benches. Even the stools are so marked to eliminate confusion.

Tool racks over each bench maintain this system of "a place for everything. . . ." For the various tool slots are worked by lettered metal strips and a tool out of place is quickly noted and recovered before it becomes permanently lost.

Burn-Out Booth Has Adjustable Burner

Stator windings are burned out in a metal booth at the French-Gerleman Electric Company, motor service organization in St. Louis, Missouri. To accommodate various stator sizes, three burners—small, medium and large—are used. Each burner can be raised or lowered to five different positions.

The 31 by 31 by 31-inch booth is constructed of No. 20 gauge sheet metal on an angle-iron frame; rests on four angle-iron legs 29 inches above floor level; has a metal hood and ex-

haust connection to provide a natural draft.

Three can-shaped burners are used. Dimensions are as follows:

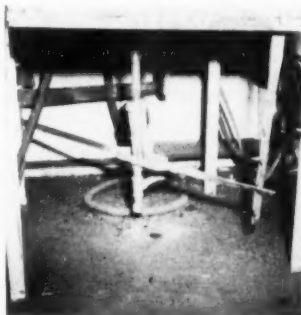
Small—1" dia.; 5½" high

Medium—2" dia.; 7" high

Large—5" dia.; 9" high.

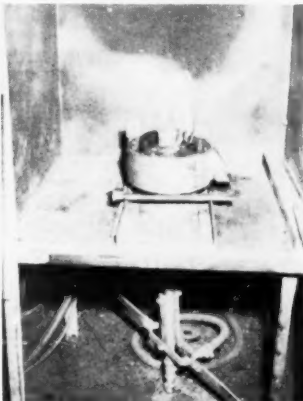
Each burner has numerous pin holes drilled around its cylindrical surface with spacing ranging from ¼-inch on the small to 1½-inch on the large unit. Burners screw on to a pipe support which protrudes up through the bottom of the booth. A flexible hose connection at the bottom of the pipe supplies natural gas for the burning flame.

One of the most flexible features of the design is the under-booth lever



LEVER ATTACHMENT under booth provides vertical adjustment of burner to five different levels notched in positioning bar.

mechanism for vertical adjustment of the burner. Connected to the burner pipe by a parallel link, and to one leg of the booth by a pin hinge, is a hand lever. This lever rests in either of five slots cut in a flat-iron positioning bar suspended from the booth a few inches in from the end of the hand lever. For narrow stators, the lowest slot is used. As stators become wider



BURN-OUT BOOTH has can-shaped, natural gas burners which mount to an adjustable pipe standard with flexible hose connection. Pipe and burner can be raised or lowered by hand lever.



BURNER UNIT screws on gas pipe standard; comes in three sizes; has pin holes drilled around cylindrical surface to distribute burning flame.

APPROVED FOR R.E.A. USE

No. 1261



SUSPENSION TYPE INSULATORS

Dead End No. 1261, 6" dia.
Ball and Socket No. 1253, 10" dia.
Cleviss Type No. 1270, 7½" dia.
No. 1271, 10" dia.

REINFORCED WIREHOLDER INSULATORS

Reinforced Type No. 1937
2¼" Screw
Reinforced Type No. 1937-3
3" Screw

No. 1937



No. 101



SPOOL TYPE INSULATORS

Secondary Rack No. 101, 1¼" dia.
Groove
Secondary Rack No. 96, 3" dia.
Groove
Service Rack No. 100, 1¼" dia.
Groove

GUY STRAIN INSULATORS

No. 502 No. 534 } Use dependent
No. 536 No. 538 } upon strength
No. 540 } and cable
requirements

No. 502



No. 175

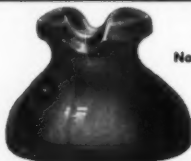


PIN TYPE INSULATORS

One Piece Pin Type
No. 135 No. 175 No. 253
No. 261 No. 266

Multi-Part Pin Type
No. 2027 No. 2045 No. 2055

No. 261



DEAD END CLAMPS, SUSPENSION CLAMPS AND FITTINGS

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ILLINOIS
ELECTRIC PORCELAIN CO.

MACOMB, ILLINOIS

(higher as placed in the booth) the lever is raised and seated in one of the other slots.

Stators are placed over the burner and rest on two angle-iron "rails" which permit air circulation and also act as re-enforcement for the oven base. After the windings are charred, the stator is removed and permitted to cool. Then one side of the winding is cut and the stator placed on a stripping table where the coils are removed with a motorized coil puller.

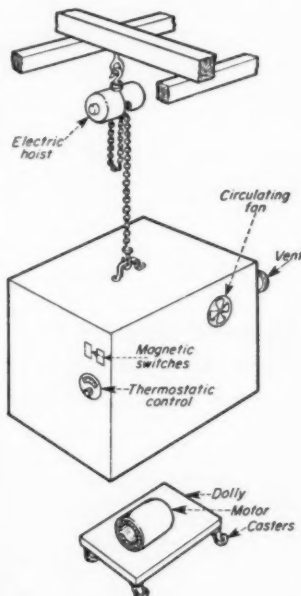
Bake Oven

Many electrical repair shops which overhaul a wide range of sizes find regular motor bake ovens too small. This is especially true for the 75 hp and over motors.

To overcome this difficulty Commercial Electric Co., Savannah, Ga., constructed its own oven, a unique installation which permits the entire oven to be removed and the base shifted about the shop on casters.

The oven is constructed of 18 gauge sheet metal with an outer shell of 26 gauge aluminum. There is a 4-inch layer of spun glass insulation between the two metal surfaces. Hooks are mounted on top of the oven hood so that it can be raised and lowered by an electric hoist.

The base of the oven, or bed, is made of ½ by 3 by 4 inch angle iron with the



OVEN, with built-in heating elements and controls, is shifted by hoist.

edges turned inside to prevent conducting heat. This forms the dolly base to which casters are attached for easy movement about the shop. The metal floor has 4-inch glass insulation, the same as the hood.

Chromolox strip heating units are installed around the top of the inside hood to prevent any possible injury to the units. An electric circulating fan is installed to provide even distribution of heat. The thermostat is wired to magnetic switches so that the current of the heating elements will not have to be broken through the thermostat. The thermostat then carries the current of the magnetic switch instead of the current of the heating units. This arrangement has worked very effectively and without trouble.

The advantages of this type of construction and design is that the dolly can be moved to the work table where motors, coils or other equipment can be placed on it, then rolled to a point in the shop where the oven does not interfere with other shop work. The hood of the oven is easily raised and lowered and since it exposed the entire bed it has the advantage over doors.

When lowered on the base the hood makes a tight fit so that there is no loss of heat. This oven mounted on casters offers flexibility in movement around the shop if necessary.

Dip Tank Has Hoist

Dipping stators, armatures and other equipment poses no handling problem in the repair shop of the F & H Electric Motor Company in Dallas, Texas. One man can pick up a 50 hp. stator,



DIP TANK WITH HOIST can be operated by one man, rolled to winding department to pick up stators, then over to bake oven. Hoist swivels 360 degrees; can balance a 50 hp. stator.

BUY ONE



GET THREE

JEFFERSON TRIPLE-VALUE Power Circuit Transformers

• When you place a Jefferson Transformer in your plant for power circuit duty you are really securing the convenience and service of **THREE TRANSFORMERS**. For Jefferson's *Universal Voltage Ratio* Design makes possible three handy combinations, 460/230—230/115—or 460/115.

Other extra values in every Jefferson Power Circuit Transformer include *assured long life* based on conservative capacity ratings that allow more than adequate safety margin; generous construction with large wiring compartments and handy knockouts; rugged cases and sturdy mounting brackets. These Transformers are the dry type, require no special vaults, and may be located on post, walls or directly on the machine. Capacities range from 50 V. A. to 15000 V. A. (460/230V.—230/115V. and 575V.—230/115V.) Sold through Electrical Wholesalers. For full details and illustrations send for Bulletin 501-15.

Approved by Underwriters' Laboratories, Inc.



JEFFERSON Electric Company

Bellwood, Illinois

In Canada: Canadian Jefferson Electric Co., Ltd., 384 Pape Ave., Toronto, Ont.

REMOTE CONTROL of LIGHT

yours *Automatically* with



POWERSTAT

Light Dimming Positioner Control

Where space is at a premium . . . where lighting scenes must be set in advance and where the utmost in automatic light dimming control is desired, POWERSTAT Light Dimming Equipment with POSITIONER Control serves most effectively.

Basically, POSITIONER dimming control consists of a motor-driven POWERSTAT Dimmer, a control circuit and a miniature dimmer control. The motor-driven POWERSTAT and control circuit can be placed in any out-of-way space and the miniature dimmer control station at the preferred location. Essentially, two types of POSITIONER control are possible. One type features various miniature stations controlling an individual POWERSTAT Dimmer. The other type is a complete, compact switchboard in miniature with multiple selector stations controlling an equal number of POWERSTAT Dimmers from a remote location. This latter type has all controls accessible to a single operator. Complete programs can be set in advance and at set time intervals, switches are actuated to concur with performance.

The miniature dimmer control has a vertically operated handle and a graduated drum with markings so that illumination intensity can be set to any degree of brilliance without actually viewing the lighting results.

To learn more about POSITIONER Control of POWERSTAT Light Dimming Equipment, write for Bulletin No. PC451.

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT



THE SUPERIOR ELECTRIC CO.,
6031 Demers Avenue, Bristol, Connecticut

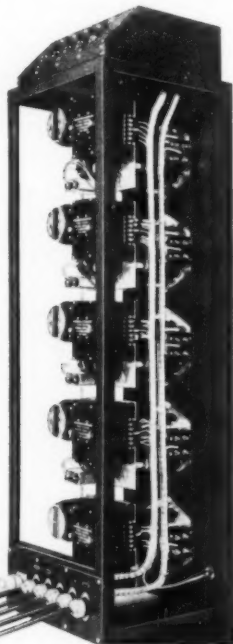
Please send me more information on POSITIONER CONTROL of POWERSTAT Light Dimming Equipment.

My Name _____

Company Name _____

Address _____

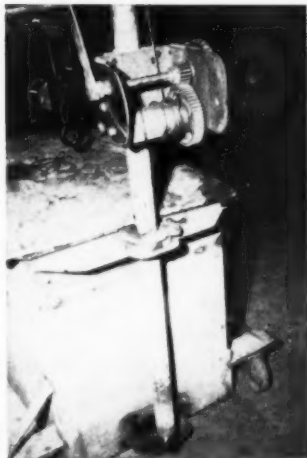
City _____ Zone _____ State _____



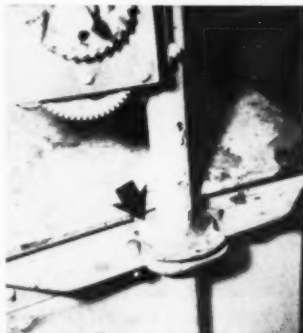
dip it and place it in the back oven without the aid of an overhead crane or hoist.

Such a one-man operation is made possible by a portable sheet-steel dip tank which has its own hoist. The unit was designed and built by co-partners T. A. Heermans and Edgar Foote; is 3-feet long, 2-feet wide and 30-inches deep; has a swivel hoist fashioned from a length of 2½-inch pipe.

The hoist boom is mounted to one end of the tank; swivels on a thrust bearing at the base and in a ball bearing at the mid-point support (4 inch by 3 inch angle-iron bracket). Tip of the hoist is 40 inches above the top of the dip tank; provides ample clearance to swing motors over tank. A steel cable hand-winch, mounted to the boom upright, is used to raise and lower the equipment.



HOIST IS MOUNTED to end of tank, swivels on a thrust bearing at bottom and ball bearing at top. Hand winch has a steel hoisting cable.



STEEL SHIELD on boom upright (arrow) keeps varnish out of ball bearing and locks hoist in stationary position.

A steel shield, welded to the hoist boom at the upper tank support, serves a dual purpose. It keeps varnish drippings out of the ball bearing and locks the hoist in a stationary position. Locking pins pass through holes drilled in the shield and supporting bracket.

The tank is supported by four, 5-inch diameter industrial-type casters which provide 1½-inch clearance from the floor. Brackets on two sides of the tank are bolted to the casters; keep them 6-inches from the tank wall; act as stabilizers when the hoist is used.

Motors up to 50-hp. in size, when suspended from the hoist outside the tank are counterbalanced by the weight of the tank and the varnish (about 600 pounds).

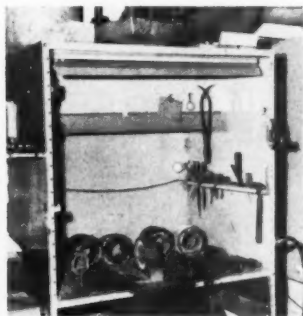
Stripping Bench Is Compact Work Area

Small motors are stripped in the shop of the Central Electric Company, Cambridge, Massachusetts, on a bench specially fitted for this purpose. Since the bench is hooded and provided with a high-capacity exhaust fan, dust, fumes and dirt are carried to the rear of the bench where light particles are sucked upwards into the exhaust duct and heavy particles are deposited into an inclined chute emptying into a waste barrel beneath the bench.

Tools required for stripping are held conveniently in an elevated rack and burned coils can be dropped into a second waste barrel beneath the area.

Lighting is from a 2-lamp standard industrial fluorescent fixture mounted above the front edge of the bench and loose particles are blown from stators by an air gun operating at 100 pounds pressure.

This working space, though limited in area, is compactly and conveniently arranged.



LIGHTED HOOD over work bench contains exhaust fan, waste chute, tool rack and facilities for stripping small motors in the shop of the Central Electric Company, Cambridge, Massachusetts.

*"Long life...
Low upkeep!"*



Speed Production...

It's 5 times faster than hand methods—this rugged - performing TOLEDO No. 999 2" Power Pipe Machine! Job-proved by thousands of users—progressive outfits like the Texas contractors described above. A machine that's right for your high-production needs today!

*Threads 2" pipe in 22 seconds
... cuts off 2" pipe in 10 seconds.
Compact... portable... efficient...
use it anywhere in your shop, plant or on the job. Your choice—Wheel or Knife Cut-Off. Toledo-built with the know-how of nearly 50 years... assuring long life... low upkeep. Write for catalog. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.*

...say users of **TOLEDO** 2" Portable Power Pipe Machines

20 YEARS! "These two Toledo #999 Machines have been in continuous hard service for more than 20 years with only routine service attention," says P. E. Hayes of J. M. Hengy Electric Co., Dallas, Texas. "All our pipe threading tools, both power and hand, are and will be Toledo." Photo taken on Dallas Power and Light Co. job.



25 MACHINES! Tooled for high production—Farwell Company, Inc., plumbing and heating contractors in Dallas, Texas, have 15 Toledo #999 Machines, 5 Toledo 2" High Speed Machines and 5 Toledo #1-2-4 Power Pipe Machines. Photo shows work on Southern Methodist University job.

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TOLEDO

PIPE TOOLS... POWER PIPE MACHINES... POWER DRIVES



..YOU WANT THIS ROTOR DESIGN...

It's Copperspun!



If you buy or use motors, chances are that most of them are of the polyphase squirrel cage type—the most widely used class of integral horsepower motors made—for sustained heavy-duty drives in almost every class of service.

In rotor design, such service separates the good from the poor—and highlights your need for Fairbanks-Morse motors with Copperspun rotors, made through an exclusive centrifugal casting procedure developed by Fairbanks-Morse.

For in Copperspun rotors, you get the benefits of superior electrical characteristics—plus a design that is mechanically stronger for withstanding the most severe working conditions.

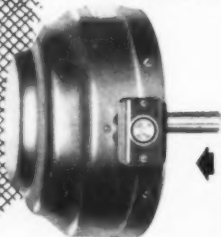
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A NAME WORTH

FOR POLYPHASE SQUIRREL-CAGE MOTORS

with *Copperspun Rotors!*

Here are a few in the complete Fairbanks-Morse line

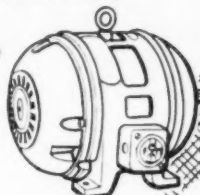


AXIAL AIR-GAP MOTORS:

Averaging 30% lighter and 40% shorter overall—with flywheel effect three times that of corresponding ratings of conventional motors. Add to appearance, decrease size and weight of any driven machine. Meet all AIEE and NEMA standards.

TOTALLY ENCLOSED FAN-COOLED

motors operate economically, safely under adverse conditions, including corrosive gas, vapors, steam or where metallic particles, abrasive dust and/or other materials are in the air. Available with Underwriters labels for use in Class 2, Group G hazardous locations.



FOR THESE EXCLUSIVE ADVANTAGES

Compare!

The Fairbanks-Morse Copperspun rotor design shows up at its best under comparison. It contrasts the mechanical strength and superior electrical characteristics of copper—against the poorer showing of aluminum and other white metal alloys. It contrasts new standards for uniformity and strength made possible through its precisely controlled centrifugal casting—against the results obtainable through standard, even old-fashioned, manufacturing procedures.

Finally, comparison drives home the virtues of indestructibility, homogeneity and high electrical efficiency. That means more satisfactory operation of motors with the Fairbanks-Morse Copperspun rotor.

ONLY COPPERSPUN ROTOR OFFERS THESE ADVANTAGES:

- ★ A truly one-piece indestructible copper rotor winding.
- ★ Withstands higher temperatures: (melting point 2,000° F. for Copper, 1,100° F. for Aluminum)
- ★ High electrical and thermal conductivity.
- ★ Dense, uniform grain structure.
- ★ Separately mounted fans: permitting complete overall machining, better quality control, better dynamic balance.



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6 REASONS

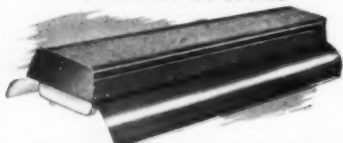
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- A unit for every lighting job! ● Easy servicing! ● Versatility in mounting! ● Flexibility of installation! ● Precision construction! ● Finest quality materials used throughout!

why architects, contractors, business executives specify LEADER Industrial Fluorescent Fixtures

In addition, Leader brings you an unusually wide variety of 40-watt, 100-watt or Slimline units, available in lengths from 48" to 96", with sturdily constructed, accessible channels. Leader also features such refinements as removable reflectors with captive latches, as removable turret-type sockets with spring-time-saving turret-type sockets with spring-pressure grip, easy yet rigid end-to-end coupling for optional continuous run installations.

STRATOLINER SERIES



IUD-240—2-light 40-w. open IUP-240—2-light 40-w. closed end
IUD-340—3-light 40-w. open IUP-340—3-light 40-w. closed end
IUD-2-100—2-light 100-w. open IUP-2-100—2-light 100-w. closed end

Durable and strongly built fixtures, neat in appearance. All-steel housing, channel and reflectors. On continuous run wireway installations 2-light sections may be grouped with 3-light or blank sections. One-piece channel for twin 40-watt sections (8' length) or 100-watt sections (10' length).

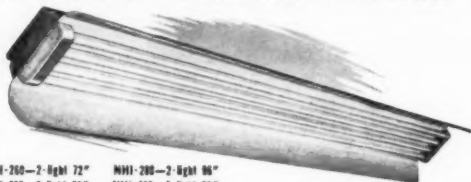
ZEPHYRLITE SERIES



ZUD-240—2-light 40-w. open ZIU-240—2-light 40-w. closed end
ZUD-340—3-light 40-w. open ZIU-340—3-light 40-w. closed end

Corrugation incorporates unusual strength and rigidity into units. No warping, twisting or sagging! All-steel housing, reflectors, deep drawn channel. 3-light units can be easily converted to 2-light whenever desired. For individual or continuous run wireway installation.

NEW HORIZON SLIMLINE INDUSTRIAL SERIES



NHI-250—2-light 72" NHI-280—2-light 96"
NHI-300—3-light 72" NHI-300—3-light 96"
NHI-450—4-light 72" NHI-480—4-light 96"

These heavy-duty Slimline fixtures bring streamlined styling to industrial lighting and provide exceptionally high light intensity. All-steel channel and reflectors. Designed primarily for continuous run wireway installations. Instant-start operation in choice of 120, 200, 300 or 425 ma. Multi-bulb units for up to 10 lamps available on special order.



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America's No. 1 Lighting Equipment Manufacturer

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Modern Lighting



JEWELRY STORE is illuminated by ceiling-mounted 3-lamp fluorescent units, R-40s recessed above display counters, and strip fluorescent units installed in wall cases. General lighting is 50 footcandles. Display lighting is 75 fc.

Triple Light Sources Give Jewelry Sparkle

Three light sources are installed in the jewelry store of Shonholtz & Sons in Los Angeles, California, to bring out the sheen of metal, the sparkle of cut stones and the detail of fine workmanship. For general illumination, 3-lamp 40-watt fluorescent fixtures are surface mounted down the raised center section of the main ceiling. Fixtures have eggcrate-louvered bottom panels; diffusing side panels to spill light to adjacent ceiling areas and minimize brightness ratios. Over floor display counters, R-40 incandescent lamps are recessed into the dropped ceiling on 3-foot centers, providing 75 footcandles to examination and display areas. The third light source is installed in wall cases, where single 40-watt fluorescent lamps are top-mounted behind the upper lip of each case. General illumination in the store is maintained at 50 fc.

Floodlighting With Mercury Lamps

A. G. Kanelos, owner of a retail business building, believes in the old adage, "Light Attracts Customers". Proof of this is the new floodlighting system he has had installed on this building located at Lawrence and Milwaukee Avenues, in Chicago.

The building, which houses seven retail stores, has been lighted with mercury-vapor units. Twelve General Electric Form 109 street lighting luminaires, equipped with 15000-lumen mercury lamps, are installed 18 feet above the pavement on a parapet which extends about four feet out from the building front. The units are spaced twelve feet apart and provide

an intensity of about ten footcandles on the building-front and sidewalk.

Mercury-vapor lamps were selected as the light source for this installation for two reasons. First, they are highly efficient, providing about 35 lumens per watt, taking into account transformer losses. Second, they give off a greenish-white color quality of light which is distinctive as compared to the color quality of illumination from standard incandescent filament lamps. This adds to the attracting power of the floodlighting, and increases its value in bringing night shoppers to these retail stores.

The lighting equipment was sold and installed by the Berry Electric Company of Chicago.

Bridge Illumination Batters Daylight

The Carey Avenue Bridge over the Susquehanna River just south of Wilkes Barre, Pennsylvania, is illuminated by Westinghouse OV-20 luminaires (IES Type 2) housing CH5 mercury vapor lamps rated at 11250 lumens. Spaced at 133-foot intervals along the 7-span 1887-foot long bridge, these lamps deliver an average illumination slightly better than 1-foot-



FLOODLIGHTING with mercury-vapor lamps in G. E. Form 109 street lighting units attracts night shoppers to seven retail stores in this Chicago business building.

FLUORESCENT
FIXTURE PERFORMANCE
DEPENDS ON
BALLAST QUALITY



SOLA *Sequenstart* CONSTANT WATTAGE BALLASTS

bring you
**cooler
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operation**

for trouble-free fluorescent
ballast performance and lower
air conditioning load.

The patented SOLA ventilated capacitor compartment reduces heat rise on the condenser by insulating the capacitor from the core's heat with a buffer of circulating air. Additionally, the patented SOLA Sequenstart[®] circuit reduces the quantity of metal required minimizing copper and iron losses. This reduces the high ambient temperature surrounding ordinary ballasts. Capacitor failure due to excessive heat is the largest factor of ballast malfunction, making cooler operation especially important.

Compare SOLA SEQUENSTART[®] with any other ballast.

Here are the significant advantages.

- Regulated light output through patented constant wattage design
- Cooler operation because of ventilated capacitor compartment
- Less wattage loss, lighter in weight and more compact.

We will be happy to answer any questions you have about ballast design and application. Write for technical bulletin J-PFL-144

Compare ballast performance—then specify the outstanding performer.

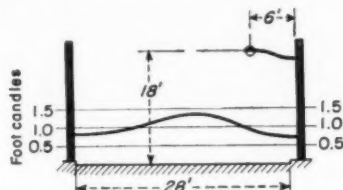
SOLA *Sequenstart*

CONSTANT WATTAGE BALLASTS

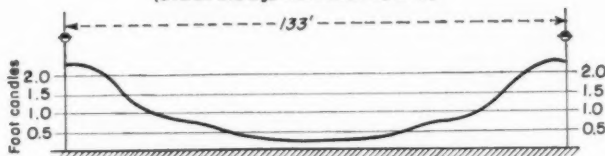
SOLA ELECTRIC COMPANY
4631 West 16th Street
Chicago 50, Illinois



NIGHT VIEW, taken directly beneath one of the luminaires, indicates that cross trusses serve as valances between lights, shielding motorists from direct glare. Pavement is safely illuminated and sidewalk along one side is also sufficiently bright for pedestrian travel.



Average Illumination Across Highway
(Overall average illumination 1.0 ft.-c)



Average Illumination Along Highway
(Overall average illumination 1.0 ft.-c)

CROSS SECTIONS reveal that light intensities average 1 footcandle, with a high of 2.4 directly beneath fixtures and a low of 0.2 halfway between them. Roadway is 28 feet wide, luminaires overhang one side of road by 5 feet, and spacing of fixtures is 133 feet in the direction of travel.

candle. While this is far below daylight intensities, observers believe that the lighting by night is more effective than illumination by day because shadows caused by the sun shining through the overhead structure are absent.

Since luminaires are mounted 2-feet above the cross trusses, these structural cross beams serve as a valance to prevent source brightness from disturbing drivers and, since luminaires

are mounted off center, the pedestrian sidewalk is lighted as well.

Luminaires are mounted on 6-foot upswEEP arms along one side of the bridge, mounted on the diagonal truss members. Ballasts are 115/230 volts, located in sidewalk handholes. All wiring is in metal conduit.

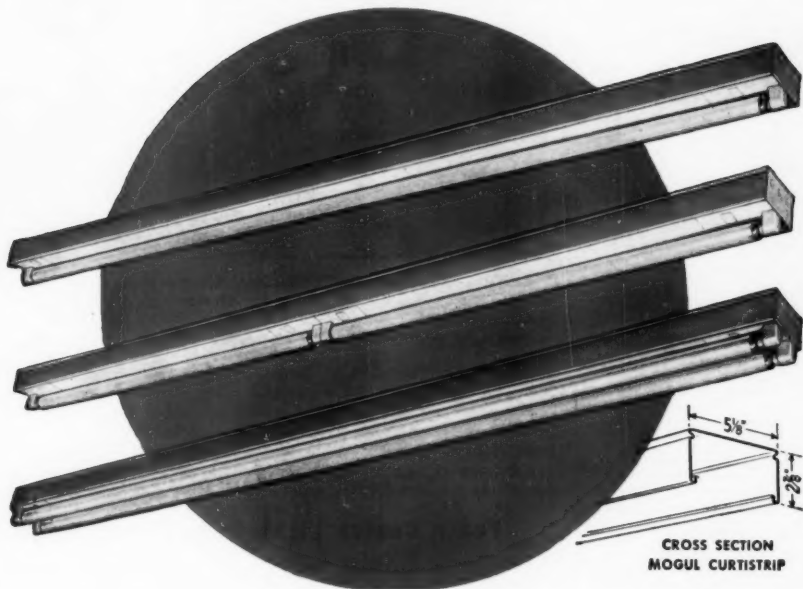
With lamps mounted above cross trusses, there is no danger of damage from the trackless trolley poles and maintenance is safe.

Lodge Room Illuminated By Ceiling Downlights

Recessed Rambusch Downlights having overall depth of 20 inches, diameters of 11 inches, apertures of 5 inches and lamps of 360 watts are mounted above the ceiling of the Westgate Masonic Lodge in Los Angeles to provide an average of 7 footcandles

to the meeting area. With apertures in the 35-foot ceiling combined with decorative motifs in the overhead panelling and design, light sources are cleverly minimized. The 10 recessed units, operated from a single location in the balcony and dimmer

and now... **MOGUL CURTISTRIP**



•The most versatile line of lighting equipment ever offered for exposed-to-view or concealed lighting applications

Architects, engineers and designers have long felt the need for a new type wire channel large enough to accommodate ballasts for operating all 4', 5', 6', and 8' fluorescent lamps—slimline, low-brightness or starter type. Mogul CurtiStrip designed and engineered by Curtis Lighting fills this need.

Mogul CurtiStrip is supplied wired and assem-

bled as complete 4', 5', 6', 8', 10', or 12' fluorescent lighting units. These units may be installed individually or in continuous lines... All component parts may also be ordered separately for assembly on the job permitting the greatest flexibility in field application. Curtis quality is found throughout which means "Specification Standard."

Write Dept. C12-15 for your copy of the special Mogul CurtiStrip Catalog.
There is no obligation.

CURTIS
LIGHTING, INC.

6135 West 65th Street
Chicago 38, Illinois

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CITY STATE

C12-15

KAYLINE
the one source lighting line

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To Sell...



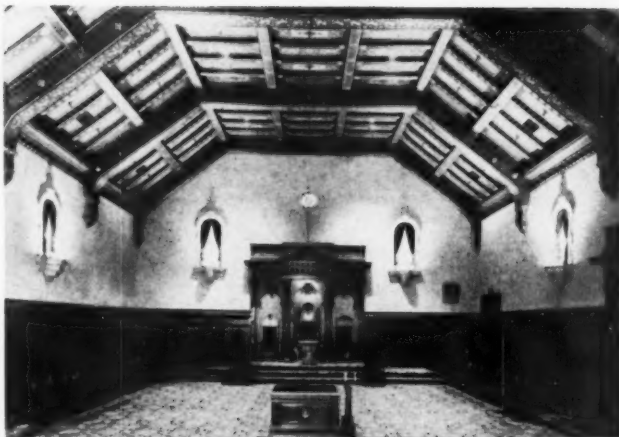
... from a copy of Kayline's new Catalogue #50 ... because in it you'll find a complete selection of the finest modern lighting fixtures available. Whether it be incandescent, fluorescent or slim-line ... commercial, industrial or residential lighting, Kayline offers the very best in modern lighting fixtures. Write, on your business letterhead, for your copy of Kayline's Catalog #50 today!

See Sweet's
Architectural
File
Section
31A-12



THE KAYLINE CO.
2480 E. 22d St., Cleveland, O.

KAYLINE
the one source lighting line



CEILING-RECESSED DOWNLITES and reflector lamps placed in wall urns evenly illuminates this Masonic Lodge for meetings, rituals and social events. Dimmer controls, installed by electrical contractor Sam C. Davis, provide means for controlling illumination levels.

controlled, were installed by Sam C. Davis, electrical contractor. Walls and ceiling areas are illuminated by 300-watt reflector lamps located around the lodge room in wall urns.

The large rug on the floor is predominantly tan in color, the walls are

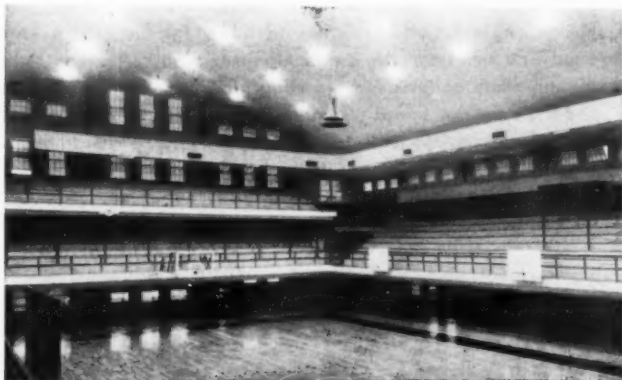
cream above dark woodwork wainscoting, while the ceiling decorations are relieved by gold. The light levels are in keeping with ritualistic requirements and means for dimming makes impressive lighting effects possible for a variety of programs.

Youth Center Lighted By Hi-Bay Fixtures

High bay reflectors, 18 inches in diameter and containing 1500-watt incandescent lamps, are mounted on 13-foot centers 38 feet above the playing floor of the John P. Lyons Youth Center, New Orleans, La. An average of 50 footcandles illuminates the basketball court, with a loading of 6.6 watts per sq. ft. Under balconies, 40 additional 200-watt units are installed to facilitate seating before games and during intermissions, although only

overhead lighting is used during contests. The ceiling is painted an egg-shell white (RF .82), the balcony a combination of grey green (RF .35) and light green (RF .64), while the walls beneath the balconies are a light grey (RF .50).

Designed by the New Orleans Public Service, Inc., the units were installed by electrical contractor Henry De Fraites. Fixtures were manufactured by the Miller Co.



INCANDESCENT high-bay fixtures furnish 50 footcandles of illumination to the playing area of the John P. Lyons Youth Center in New Orleans.

You can save \$570

for every 10,000 square feet in your plant with Westinghouse Bus Duct

"On a recent field survey made by our Sales Engineering Division for the application of 440-volt plug-in bus duct versus wireway, it was found that for a complete bus-duct system the installed cost was \$17.30 per 100 square feet, whereas for a complete wireway system with taps, the cost was estimated at \$23.00 per 100 square feet. This cost does not evaluate all the advantages that plug-in duct offers for ease of making taps under safe conditions without shutdown."

The Buffalo Electric Co., Buffalo, N. Y.



Many plants have found in Westinghouse Bus Duct a system of power distribution impossible to match for low installed cost and high carrying capacity in limited space.

Westinghouse Duct, in completely prefabricated sections, varying in length to suit requirements, is convenient to handle and easy to hook up. The longer the run, the greater the saving.

And Duct is easily disassembled for quick expansion or changeover—critical today when equipment must operate at uninterrupted top capacity, top efficiency.

Experienced Westinghouse Field Engineers can help you plan your secondary power distribution system. Phone your nearest Westinghouse Office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-30046

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Square Feet	Bus Duct	Wireway	You Save
1,000	\$ 173.00	\$ 230.00	\$ 57.00
10,000	1,730.00	2,300.00	570.00
20,000	3,460.00	4,600.00	1,140.00
50,000	8,650.00	11,500.00	2,850.00
100,000	17,300.00	23,000.00	5,700.00
250,000	43,250.00	57,500.00	14,250.00



YOU CAN BE SURE... IF IT'S
Westinghouse

BUS DUCT



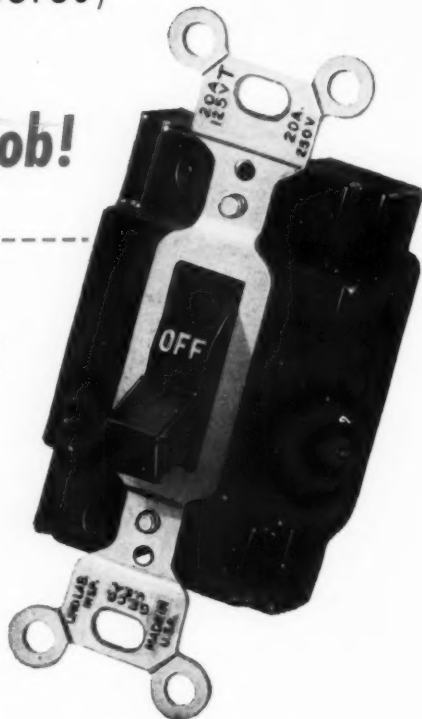
G-E HEAVY-DUTY SWITCHES

(for 20 and 30 amperes)

***Built to stay
on the job!***

Tough construction and smooth action are the double features that make G-E heavy-duty switches important wiring news!

These tough, T-rated switches are protected by an over-all plastic housing. Housing is extra shallow for extra wiring space in boxes. Pressure connectors, designed for convenient back wiring, make installation quick and easy.



General Electric heavy-duty switches are available in single-pole, 3-way, double-pole, and single-pole quadruple break types.



WIRING DEVICES
for home and industry

Try G-E heavy-duty switches at your most troublesome locations. See why they can take abuse in stride. For complete information write Section D65-318, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.

GENERAL  ELECTRIC

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want some manufacturer's catalog?

want a bulletin about some piece of equipment?

want more information on products or services advertised?

want advice on a technical problem?

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Save time, trouble and money. We will tell each manufacturer to send you the information you want. Instead of writing many letters to get the material you need, just fill in this easy-to-use postcard and we will do the rest. For years we have been rendering this service on catalogs and bulletins . . . now we expand this service to include every department. It's free . . . It's as useful as you make it.

other problems? turn the page for the answer.

We suggest that you tear out the bottom card before you start reading the following pages. Keep the card handy. You might even use it as a book mark in case you are unable to complete reading the following pages at one sitting. Then, as you see some new products about which you want to know more, just circle on this card the number which appears at the top of the item describing the new product or catalog. Circle each number on this card which corresponds to the number on the item in which you are interested.

If you want to know more about something which is advertised in this issue, put the number of the page on which the advertisement appears in one of the squares at the bottom of the card. If you want further information on the product advertised on page 16, for example, just put a 16 in one of the squares. When more than one advertisement appears on a single page, include the manufacturer's initials together with the page number (16-ABC).

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- • • to get more information on new products
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330 West 42nd St.
New York 18, N. Y.

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330 W. 42nd St., New York 18, N. Y.

Not good
after May 1st

Please send me without obligation, the new product information or catalogs described on the following pages and identified by numbers circled below.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
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40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
60	61	62	63																

Advertising
on page . .

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NAME.....TITLE.....

COMPANY.....

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Electrical Construction and Maintenance is written for you by a large staff of editors and consultants, each an authority on some phase of the business. They will be glad to give you expert advice and answers to your questions.

other problems? turn the page for the answer.

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New York 18, N. Y.

USE THIS CARD TO ASK THEM!

Do you have a problem in wiring layout, motor control, lighting technique?

Ask the editors.

Do you want advice on cost analysis, billing procedures, market conditions, or government regulations?

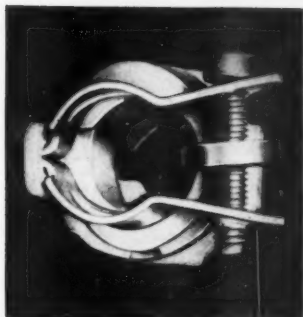
Ask the editors.

Do you have a gripe? Want to read more articles on some subject? Want to ask a question about some article you read in this issue?

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Product News



Connectors

(1)

Announcement has been made of new hinged type fittings that save time on the job because they are double hinged and thus automatically center the cable or conduit when the connector is tightened. Fittings have a $\frac{3}{8}$ inch throat, and a range of $\frac{1}{8}$ inch to $\frac{1}{2}$ inch on the clamp. No. C-4 has a shoulder stop for armored cable. No. C-9 has no stop for non-metallic or rubber cord.

Gedney Electric Company, RKO Building, Radio City, New York 20, N. Y.



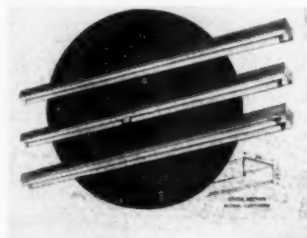
Tape

(2)

Announcement has been made that Labelon tape is now available in four colors, four widths and two lengths. The new pressure-sensitive tape on which you can write or type is waterproof, oil-proof, acid-resistant and will withstand a temperature range of from -40° to 150° F. Made of two layers of acetate with a special white waxy substance laminated between, identification cannot be erased, smudged, or rubbed off. The tape sticks without

moistening to wood, metal, plastics, tile, rubber, glass and it can be transferred from one surface to another repeatedly without leaving a sticky residue or losing its adhesive power. It is recommended for labeling electrical apparatus, fuse boxes, switches, controls, motors, spare parts, panel boards, for identifying electrical circuits and wires pulled through conduits.

Labelon Tape Company, 100 Anderson Avenue, Rochester 7, N. Y.



MOGUL FLUORESCENT Curtistrip is a new line of lighting equipment for exposed-to-view or concealed lighting applications. It supplies the need for a wire channel large enough to accommodate ballasts for operating all slimline, starter type and low brightness fluorescent lamps. The steel wire channel is $5\frac{1}{2}$ inches wide by $2\frac{7}{8}$ inches deep and is available in 4-, 5-, 6-, 8- and 10-foot lengths. Continuous lines at any length can be made by the use of steel channel coupling. It offers single or twin lamp operation. Manufactured by Curtis Lighting, Inc., 6135 West 65th Street, Chicago 38, Ill.

Floodlights

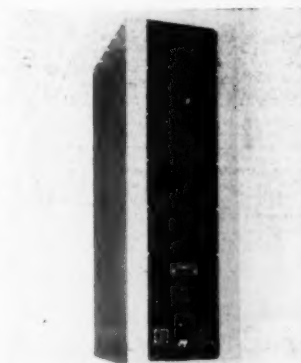
(4)

New, weatherproof cluster lights for outdoor protective lighting, factory, yard lighting, boundary fence lighting and other industrial area floodlighting applications are provided with the Stonco cluster box No. 25. Designed to conserve critical aluminum, the unit combines aluminum alloys that are die-cast under pressure to provide greater structural strength with less aluminum by weight than in conventional wiring troughs available for the same purpose. A removable cast aluminum cover plate sealed with a cork gasket provides access to inside wiring. Each box has six holes tapped $\frac{1}{2}$ inch IPS to take from one to five



standard lampholders for the 150-watt, 200-watt and 300-watt outdoor weatherproof reflector bulbs. Accessories available include slip fitters for pipe mounting and brackets for wall mounting, although mounting directly to $\frac{1}{2}$ inch conduit is made without accessories.

Stone Manufacturing Company, Elizabeth 4, N. J.



Induction Regulators

(5)

A new line of three phase, dry-type, induction voltage regulators has been announced. It includes both self-cooled and forced-air-cooled regulators in standard 10% and 20% (raise and lower) ranges of regulation. It is offered in ratings from 120 to 600 volts and from 12 to 85 kva. Housed in an all-steel, ventilated cabinet, the unit is protected from dust collections by cabinet design.

General Electric Company, Schenectady 5, N. Y.

ALWAYS A WISE CHOICE

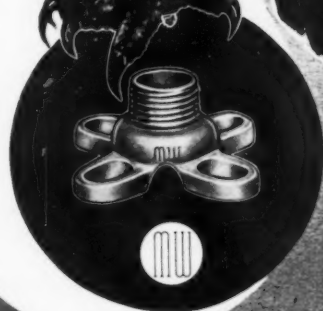
midwest
**MODERN
FITTINGS
FOR**

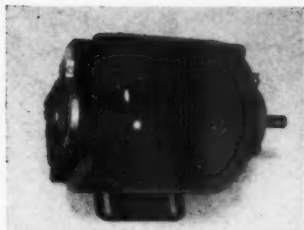
- service entrance cable
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- lighting fixture fittings
- flexible steel conduit
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Electrical Wholesalers*

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Representatives in Principal Cities





Attic-Fan Motor (6)

A new motor designed for use with vertically- or horizontally-operated belt-driven attic fans is available. Motor-bearing construction is designed to carry thrust loads caused by weight of rotor and pulley, and vertical operation of motor with shaft extension up or down is permissible. Available as a split-phase, 115 volt, $\frac{1}{4}$ or $\frac{1}{2}$ hp, type FHT motor, or as a capacitor-start, 115/230 volt, $\frac{1}{2}$ hp, type FJ motor. Temperature rating of type FHT is 50° C continuous, type FJ is 40° C continuous. Both types are externally reversible.

Westinghouse Electric Corp., Pittsburgh 30, Pa.



Control (7)

New voltage sensitive control, type VSA, for switching capacitors has been announced. This control, operating in conjunction with Kyle Type "GR" oil switches, will automatically connect banks of capacitors to an electrical system when they are needed and disconnect them from that system when their effect may become undesirable. It can also be adapted, by the use of additional external relays, to most solenoid or motor driven circuit breakers and switches which are available. Control consists of a contact making voltmeter, selector relays, and an adjustable time delay unit. Also provided are a fuse for control circuit protection, potential test terminals for connection of an external voltmeter, toggle switches providing manual control of device or devices being con-

trolled, a means of minimizing contact erosion and a means of eliminating radio interference. It is designed for operation from 120 volt, 60 cycle ac.

Line Material Company, Milwaukee 1, Wis.



Motor Base (8)

A new, light weight, adjustable, tilting motor base for use with fractional motors up to one horsepower has been announced. It is adjustable in width and length to accommodate all sizes and types of fractional hp motors. In addition to using it with variable speed pulleys, it also acts as a belt tightener and can be used for easy belt changing on cone step pulleys. Speed changes can be made while machine is in operation. It maintains the correct belt tension and alignment. Exact speed control is obtained by turning a handle screw adjustment. Size is 5½ inches by 7 inches.

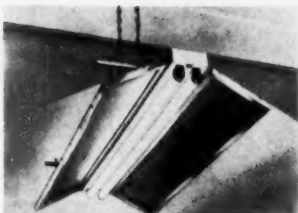
Lovejoy Flexible Coupling Co., 5253 West Lake Street, Chicago 44, Ill.



Test Light (9)

Announcement has been made of a new test light featuring large voltage range. It is designated as Lo-Volt test lite No. 1300 and is encased in a plastic housing. Flexible leads, with heavy durable coverings, 10 inches long are terminated in convenient spring clips. Plastic bulb lights up on any voltage from 3 to 25 volts ac or dc. It is especially adaptable for use with low voltage controls such as thermostats, and may also be used with a battery supply to test for continuity.

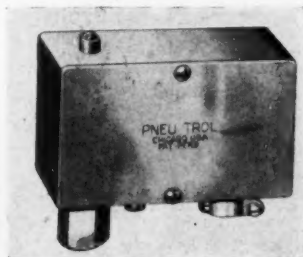
Industrial Devices, Inc., Edgewater, N. J.



Combination Fixture (10)

Announcement has been made of the "Directory," a unit combining a suspension radiant heater and fluorescent light fixture for industrial and commercial applications. The bulb temperature of the fluorescent unit of the Directory remains constant regardless of whether the radiant panels are on or off. At the same time the panels act as mirror reflectors for the fluorescent lighting. Ra-Grid radiant glass heating panels are made of shatter-proof glass with aluminum grids, in aluminum frame. Adaptable to almost all 48 inch fluorescent drop fixtures. Power rating is 1500 watts per one suspension unit (two radiant heat panels) 110/220 volts ac or dc. Heat rating 5,100 Btu. Height of suspension for effective heating is 8 to 10 feet above floor surface.

Salton Manufacturing Co., Inc., 74 Reade Street, New York 7, N. Y.



Control Switch (11)

A new time delay control switch for electric solenoid valve controls used with air or hydraulic cylinders has been developed. Small, compact in design, and sturdily made, it is easily adjusted to provide any delay within the ¼ to 10 second range. Its small size permits it to be mounted near the mechanical stop without interfering with machine movement. Switch automatically resets itself after each actuation. Time delay adjustments are made by turning the knurled adjustment screw, which moves switch position in relation to piston lever arm.

Pneu-Trol Devices, Inc., 1436 N. Keating St., Chicago, Ill.



OK!

**Fully Approved
for all types of
branch circuit wiring**



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Wire-Nuts®

Patented, No. 1,933,555
THE SOLDERLESS, TAPELESS WIRE CONNECTORS

Speed Up Any Wiring Job



IDEAL "Wire-Nuts" are approved for conduit, armored cable, non-metallic sheathed cable and open wiring.

IDEAL "Wire-Nuts"—the easiest way known to connect two or more wires—meet or exceed every requirement for all types of branch circuit wiring. Contractors' sizes 74B and 76B are listed by Underwriters' Laboratories as pressure cable connectors for general use. This broad approval means they are accepted for use with conduit, armored cable, non-metallic cable or open wiring systems. IDEAL "Wire-Nuts" are your safest, surest way to make approved wire joints. **NO SOLDER, NO TAPE, NO TOOLS**—just screw on "Wire-Nuts". You can't make a better wire joint—but IDEAL "Wire-Nuts" can save you time and money on every wiring job. For all usual wire combinations.



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Please send me free sample of IDEAL "Wire-Nuts"

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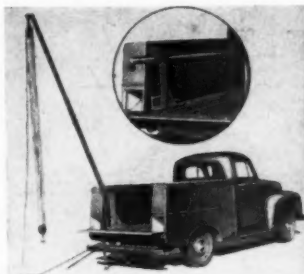
CITY _____ ZONE _____ STATE _____



Switch, Outlet, Wall Plate (12)

A new one-piece combination single pole T-rated switch, outlet and wall plate has been announced. Switch and contacts are enclosed in a dust-proof housing. It fits any standard outlet box, and is approved by Underwriters Laboratories. For use in home, office, industrial, commercial or institution, it provides an extra outlet at the switch. The switch is independent of the receptacle. The T-slotted receptacle has double-wipe phosphor bronze contacts. Brass binding screws are for side wiring and will take No. 8 wire.

John I. Paulding, Inc., New Bedford, Mass.



Derrick

(13)

A new telescopic, single-leg derrick, for $\frac{1}{2}$, $\frac{3}{4}$ and 1 ton trucks, has been announced. The unit, which has been designated the "Uni-Lift", is designed for use with multiple pulley blocks. It has a maximum capacity of 1500 lbs. The derrick base is keyed to permit positioning of the boom at two angles of elevation. The derrick is raised semi-automatically by means of a heavy-duty elevating spring. When not in use the boom is stowed in a telescoped position along the body side panel where it will not interfere with items carried in the loading area.

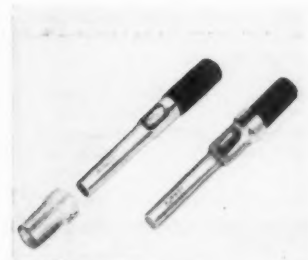
Powers-American Division, McCabe-Powers Auto Body Company, 5900 No. Broadway, St. Louis 15, Mo.



Combination Tool (14)

A combination portable electric hammer, drill and grinder, called "Do-All," has been announced. It is used for drilling concrete and masonry; drilling metal and wood, and driving, grinding, buffing and wire wheels. It is equipped with ball-bearings with sealed lubrication. Hammer member may be taken apart for cleaning and greasing, while switch and carbon brushes can be replaced quickly. It is operated by a universal motor with fan ventilation and has switch located in handle. It operates on either dc or ac, from 25 to 60 cycles. It also has a ten-foot cord with strain reliever.

Wodack Electric Tool Corp., 4627 W. Huron St., Chicago 44, Ill.



Meter Entrance Plug (15)

Announcement has been made of a new meter entrance Hyplug, which is an indent-type lug for bringing entrance cable into watthour meters. The cable is indented to the Hyplug with a standard Hytool or Hypress. Slipping a nylon sleeve over the barrel insulates the assembly. Available for any combination of meter openings and cable sizes, it eliminates the need for solder and provides a low resistance joint. Nylon insulating sleeves are available for most cable sizes.

Burndy Engineering Co., 107 Bruckner Blvd., New York 54, N. Y.

OK!



TRY THESE FOR Safer, Faster, Lower Cost Electrical Maintenance

DOUBLE PROTECTION

Voltage Tester



Takes the danger, lost time and guesswork out of many kinds of testing. Not just a "glo" type. Solenoid indicator shows nominal line voltages on a calibrated scale. Neon test lamp operates independently—either will work if the other fails. Strong, dust-tight case protects working parts. Test prods are heavily insulated, with safety collar and 4-inch handles. Reliable and easy to use. Fits and belongs in every electrician's pocket!

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FUSE CLIP CLAMPS

Save Up to 6%
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Reduce resistance between clips and fuses or switch blades. IDEAL Clip Clamps eliminate power loss—arcing, burning or heating of wires and cables—conserve fuses and clips. Real maintenance reducers that pay for themselves and last a lifetime! Seven sizes, knife or ferrule type.



FUSE REDUCERS



No need to change switch, panel or switchboard. Should be used whenever new circuits are built with plans for future increase in power load; install larger fuses later. Snap into clip like ordinary fuse. Standard sizes for N.E.C. cartridge fuses. Knife or ferrule type.

Ideal Wiring Devices are Sold Through America's Leading Distributors

"Safe-T-Grip" FUSE PULLER



Never take a chance by pulling or replacing a cartridge fuse by hand! Play safe—use a "Safe-T-Grip". Gives you a full, positive grip that can't slip. Rugged, laminated fibre construction—high dielectric. The "standard" in many industrial and utility plants. Three sizes for small, medium and high-capacity fuses.

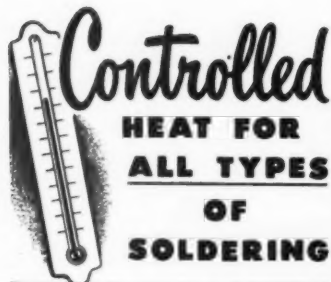
IDEAL FREE CATALOG DATA

IDEAL INDUSTRIES, Inc.
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Please send catalog data on:

- ☐ Voltage Tester
- ☐ "Safe-T-Grip" Fuse Puller
- ☐ Fuse Clip Clamps
- ☐ Fuse Reducers

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CITY _____ COMPANY _____
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With 250-Watt WELLER GUN

No need to change tools for light or heavy soldering. The 250-watt Weller Soldering Gun does both with controlled dual heat. 3-second heating saves time and current on every job. Your Weller Gun pays for itself in a few months.

Check These
Time-and-
Money
Saving
Features



TRIGGER-SWITCH CONTROL—Governs heat for light or heavy work. Saves power because no need to unplug gun between jobs.

SOLDERLITE—Spotlights the work. Lets you see what you're doing at all times.

3-SECOND HEATING—No waiting, no wasted current. Saves hours and dollars each month.

LONGER REACH—Lets you get at any job with ease. Slides between wiring—into the tightest spots.

STREAMLINED—Compact and comfortable to hold. Pistol-balanced for fast precision soldering.

RIGID-TIP—Chisel-shaped. More soldering area for faster heat transfer. "Over-and-under" terminals give bracing action.

DUAL HEAT—Single heat 200 watts; dual heat 200-250 watts; 120 volts, 60 cycles.

See the new 250-watt Weller Soldering Gun today at your distributor—or write for bulletin direct.

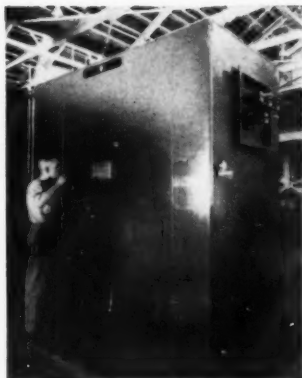
SOLDERING GUIDE—Get your new copy of **SOLDERING TIPS**—revised, up-to-date and fully illustrated 20-page booklet of practical soldering suggestions. Price 10c at your distributor, or order direct.



WELLER

ELECTRIC CORP.

815 Packer Street, Easton, Pa.



Transformers

(16)

New hermetically sealed dry-type transformers with Class B insulation have been announced. They are available in ratings up through 1500 kva and 15,000 volts. They can be supplied with G-E metal-clad switchgear for load center installations or with network protector and high-voltage switch as a completely equipped network unit. Transformers are nitrogen filled and can be installed either outdoors, where there is no exposure to lightning, or indoors. They can be installed underground where moisture, dust, lint, corrosive fumes, etc., have previously required either the use of liquid-filled units, or excessive maintenance on conventional open dry-type transformers.

General Electric Company, Schenectady 5, N. Y.



Instrument

(17)

Two new direct reading Rotameters have been announced. No. 1860 is graduated in inches and tenths of inches. One revolution of the large dial equals ten actual inches. Small right hand dial totalizes tens inches, left hand dial hundreds of inches. Recommended for charts, plot plans and maps. Letters are in black. No. 1864 calibrated for $\frac{1}{2}$ inch scale plans will give the proper meas-

urement without any calculations when used with $\frac{1}{4}$ inch scale. Large dial reads to 100 feet, small right hand dial reads hundreds of feet and left dial reads thousands of feet. Will totalize to 10,000. Letters are in blue.

R. A. Koehnman Co., 1408 Delmar Blvd., St. Louis 3, Mo.

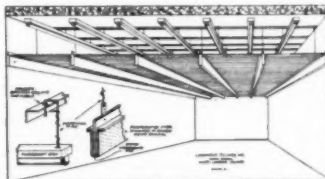


Tool

(18)

This new automatic tacker staples braided, rubber-coated, single and double strand wire hollow tube lines. Front and rear guides circle the wire and permit rapid drawing around difficult angles or corners, along baseboard, plaster walls, window frames, ceilings, door jambs and rafters. It uses an improved staple, made in several colors. It drives the staple to a desired depth without marring or injuring the wire.

The Heller Company, 2153 N. Superior Ave., Cleveland, Ohio.



(19)

ACUSTI-LUMINUS ceilings offer glareless, shadowless, even light, coupled with acoustical treatment. Below the fluorescent tubes is hung a ceiling of thin translucent corrugated plastic. Footcandles may be regulated by varying the number of fluorescent sources above the plastic ceiling. Manufactured by Luminous Ceilings, Inc., 2500 W. North Ave., Chicago 47, Ill.

EASY ON THE EYES and easy on the budget!



Skylike—the new kind of lighting that looks like fluorescent but has silvered-bowl incandescent features—has basic advantages that make its installation and maintenance more economical than for most lighting equipment.

Skylike units reduce job time because they are lightweight. They weigh only 15 pounds—are 50% or more lighter than other recessed lighting units . . . require less support.

Skylike units are simple in construction and

internal wiring. Because there are no starters, ballasts, or transformers to get out of order, service call-backs are virtually eliminated.

Maintenance men, too, like the ease with which a Skylike unit can be relamped . . . the way its easily accessible baked enamel reflector wipes clean with only a damp cloth.

Try Skylike units on your next lighting installation—it's the only lighting system that offers *all* the advantages listed below.



1. High initial and maintained light output—Built-in ceiling reflector provides 87% reflection . . . eliminates loss of light due to darkening walls and ceilings. Baked enamel finish does not discolor. Silver reflecting surface of lamp is hermetically sealed against dirt and corrosion.
2. Ideal light characteristics—Skylike lighting provides softly diffused shadows, comfortable low-brightness levels, and the warm color preferred by merchandising experts.
3. Easily converted for directional or accent lighting. A semi-silvered-bowl lamp and a simple accessory replace the original lamp.
4. No flicker, no blink, no hum—Skylike units operate without starters, ballasts, or transformers . . . start the instant the switch is thrown.
5. Low installation cost—Lightweight Skylike units require only minimum supporting construction, require no special installation skills.
6. Variable lumen output—150- to 500-watt lamps are interchangeable in Skylike units—provide lighting flexibility of 2,500-10,000 lumens.
7. Low initial investment—Skylike lighting costs only $\frac{1}{2}$ to $\frac{1}{3}$ as much as other equipment delivering comparable results.
8. Wide architectural latitude—Skylike units fit 24" x 24" ceiling tiles . . . can be fully or partially recessed or surface-mounted—in rows or patterns.

SILVRAY
Skylike
*Patent pending



Send coupon for Skylike booklet

Graybar Electric Company, Inc.
Graybar Building
420 Lexington Avenue
New York 17, New York

Please send me a copy of "Skylike Louvered Incandescent Lighting Systems."

Name Title
Firm
Address
City Zone State

5112

*For Good Lighting Plus
Easy Maintenance*



WHITER
THAN
WHITE



ABOLITE DUO-MOVE SYSTEM

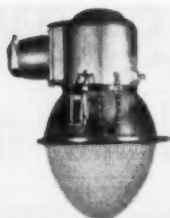
The formula for Good Lighting is the combination of proper equipment and simple methods of maintenance. The Abolite Duo-Move System encourages regular cleaning habits because Duo-Move units can be cleaned and relamped quickly and safely without using clumsy ladders. Merely a twist of the wrist—reflector and lamp assembly can be removed and serviced—another turn and it's back in position . . . no interruption to workers . . . no lost time. The Abolite Duo-Move System guarantees maximum illumination with minimum service expense. Write for the Duo-Move story today!

THE JONES METAL PRODUCTS CO.,
West Lafayette, O.



WHITER THAN WHITE

ABOLITE
Lighting



Street Light Unit

(20)

A new type AK-6 enclosed street-lighting luminaire for residential, rural, and suburban areas (1000 and 2500 lumen lamps), is available. Standardized variations of the unit meet requirements for top or side mounting, inner or outer wiring, and high- or low-voltage multiple circuits. A choice of service is provided by a selection of small heads for multiple circuits, universal heads for multiple or series service (up to 5000 volts), and porcelain heads for use with circuit voltages in excess of 5000 volts.

Westinghouse Electric Corp., Pittsburgh 30, Pa.

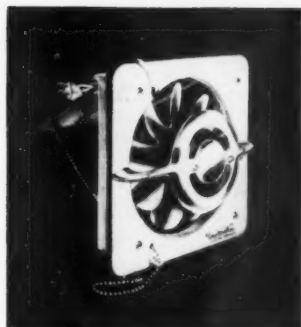


Bushing

(21)

A new male thread insulating bushing has been announced. A feature is the ribbed outer surface to facilitate installation by providing a sure-grip. Ribs may also be used as a driving point for tapping bushing with a screwdriver. Other features are deep threads for easier spin-on, and smooth, rounded edges for protecting wire insulation during pulling and when in service. This bushing may be used in conjunction with either a locknut or O.Z. type A insulating bushing.

O. Z. Electrical Mfg. Co., 262 Bond Street, Brooklyn, N. Y.

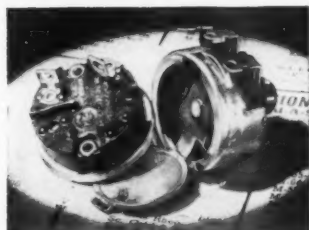


Ventilator

(22)

Announcement has been made of a new Ventrola utility ventilator, Model 80. It is primarily designed for basements and utility rooms to remove excess moisture caused by automatic laundry equipment. It is a "one-unit" glass area installation. Its weather-proof, ultra-thin design features chrome grille—white, porcelain-type enamel face plate—fully enclosed motor, shielded to prevent radio and television interference—rust preventing aluminum finish on all exposed parts. It is also suitable for kitchen, bathroom, bedroom, recreational room or office installation. It operates on 60 cycles, ac, 110 volts.

National Appliance Co., 4814 W. Vernor Hwy., Detroit 9, Mich.



Controls

(23)

Announcement has been made of a new pry-off dust cover of Ad-A-Switch replacement controls. The new construction features a single-piece metal casing with scored center section and tab. This section prys open and tears off, leaving the control casing open to take the proper Ad-A-Switch. Two lugs on the switch engage with side straps, and are slightly bent to hold the switch firmly in place. Switch mechanism and control rotor are aligned so that the assembled unit functions smoothly. There is a choice of six types to meet any switching need.

Clarostat Mfg. Co., Inc., Dover, N. H.

3-Speed Milwaukee 1/2" Drill Cuts Cost of Electrical Work

Exclusive Milwaukee HOLE-SHOOTER combines straight and right-angle drilling . . . wonder-tool for close quarters

Built for use by electrical contractors and plant maintenance electricians, this Milwaukee 1/2" HOLE-SHOOTER — *America's only 3-speed Right-Angle Drill* — has demonstrated its unmatched time-saving performance on thousands of jobs. Most powerful drill built for its size and 9-lb. weight. Ball and roller-bearing equipped for extra-long service life.

You'll be amazed at its versatility — unit-built for quick change to suitable speeds for drilling in wood, metal, masonry, concrete, tile. Uses wood bits up to 3" . . . also 1/2" carbide-tipped drills.



Head swivels full 360°. Locks in any position.
S-412 Drill with "2-speed Right-Angle Drive" . . . \$69.00



For straight drilling, S-412 1/2" HOLE-SHOOTER (above) has a chuck speed of 450 R.P.M. With the 2-speed "Right-Angle Drive" attachment, speeds are 300 R.P.M. or 675 R.P.M.



3 flats specially machined on shanks of these bits to fit Jacobs 3-jaw chuck.

Other bits available also — See assortment at left. We can supply you with any size wood-boring bits up to 3". Write us.

Complete S-412 Tri-Speed Kit Contains

- 1 — S-412 1/2" HOLE-SHOOTER, Jacobs geared chuck.
- 2 — 2-speed "Right-Angle Drive" attachment.
- 3 — 3 special bits — 3/4", 1 1/8", 2 1/8".
- 4 — Special wrench.

*Pat. Pending

Complete S-412

KIT..\$87.00

Call your distributor today, or write us and give his name.

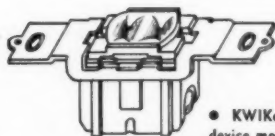
MILWAUKEE ELECTRIC TOOL CORP.

Makers of portable electric drills, saws, hammers, grinders, sanders, and accessories.
5352 W. STATE STREET • MILWAUKEE 8, WIS.

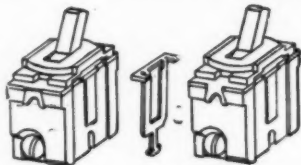
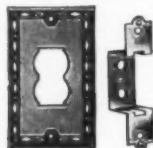


Now!

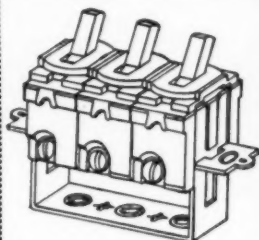
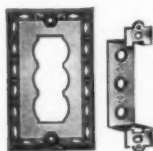
... all
Leviton switches
 in the
 * **KWIK change Line**
 are "**T**" rated



• KWIKchange single device mounted on strap



• • KWIKchange two device assembly showing separators between devices to hold each firmly in place.



• • • KWIK change three device assembly with the devices simply sliding into strap.

It is so quick and easy to make any combination of devices with the *KWIKchange line . . . every type of device, two gang plates, handy and round box covers are available.

The complete **LEVITON LINE** of switches, receptacles and sockets is designed to meet specifications and budgets for every type of job.



. . . see your distributor for the **LEVITON** line

Leviton Manufacturing Company

Main factory and offices: Brooklyn 22, New York

Warehouses: Chicago and Los Angeles Canada: No. 2 Bd. of Trade Bldg., Montreal



Transformers

(24)

Announcement has been made of new motor starting transformers of the auto type and wound three phase open Delta with taps at 50%, 65%, 80% 100% of line voltage. They are built to conform to NEMA standards for medium duty. Standard types are available in sizes from 5 hp to 200 hp in both 220 and 440 volts, 50/60 cycles. Special voltages as well as two phase units and other frequencies can also be obtained.

Etraco Manufacturing Co., Inc.,
 Woods Church Road, Flemington,
 N. J.



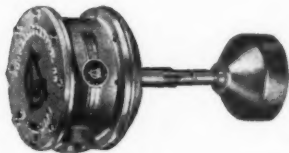
Power Supplies

(25)

A new line of standard, metal-enclosed dc power supplies utilizing selenium rectifier stacks has been announced. Applicable wherever dc power is required, the new conversion equipment may be used for excitation of synchronous motors; operation of dc elevators, cranes and machine tools; and for conversion of ac feeders to dc. Designed for indoor installation, the rectifier units are mounted in a metal casing consisting of one to four separate sections, mounted vertically, one on top of the other, and bolted together. A removable front, wire-mesh panel permits access to all com-

ponent parts. Units can be furnished to supply either 125 or 250 volts dc from a 208, 230 or 460 volt, three-phase, 60 cycle ac supply. Convection-cooled equipments are available in ratings of 0.75, 1.5, 3, and 5 kw. Fan-cooled units are rated at 7.5, 10, 12.5, 15, 18.5, 20 and 25 kw. When larger ratings are required, two or more rectifier units may be connected in series and/or parallel to increase the current or voltage rating.

General Electric Co., Schenectady 5, N. Y.



Emergency Alarm (25a)

Announcement has been made of a new Autocon Hi-Level safety switch, designed to operate either audible or visual alarms. It needs only $\frac{1}{2}$ inch rise in water level above normal to operate. It is independent of all other controls. It is a non-float, non-electrode device and is not affected by low temperatures. Switch can be used in all operations where auxiliary warning is important should levels rise above normal.

Automatic Control Company, 1005 University Avenue, St. Paul 4, Minn.



Nail Straps (26)

Announcement has been made of new one-piece malleable iron nail straps for use with armored cable, non-metallic cables, rigid conduit and EMT. They are also useful for other strapping purposes, such as service entrance cable. The long spike provides dependable holding. They are built to take the severest treatment without breaking.

Gedney Electric Company, RKO Bldg., Radio City, New York 20, N. Y.



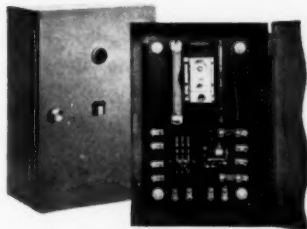
**RECOGNIZE
THIS
WARD?**

"Finest hospital in the State", so this hospital was tagged when it was built just a few years ago.

But the charred ruins that remain today prove — too late — that even modern fireproof construction is not protection enough. There *will* be fires — and only positive protection can hold losses down . . . positive protection that *starts* with adequate warning — a way to call help fast.

For more than 17 years, Couch has specialized in Fire Alarm systems geared to hospital needs. Each type offers around-the-clock protection . . . constant assurance that when you need help you can get it *quickly*. Find out which Couch Fire Alarm System is best for you by writing today for Bulletin 116.

Fire Alarm System FS-1
— one of several types of Couch protective equipment . . . uses manual or automatic stations (self-restoring or partially self-restoring) . . . choice of a wide variety of signal alarms.



S.H. COUCH CO., INC.
DEPT. 803 NORTH QUINCY 71, MASS.

Private telephones for home and office . . . hospital signaling systems . . . apartment house telephones and mail boxes . . . fire alarm systems for industrial plants and public buildings.

No wonder the big trend's to AMPLEX SWIVELITES



Swielite Hood units in Mace Jones Furniture Store, Kansas City, Kansas, supplied by W. T. Foley Electrical Supply Co., Inc.; lighting layout by John Maultsby, Architect.



THE PLAIN FACT is that Amplex Swivelites give the most for your money. They're smartest-designed... and made of aluminum with a permanent satin finish.

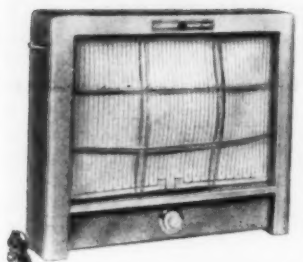
Special air-flow ventilation reduces burn-outs. Their exclusive double-ball swivel gives instant, positive, fingertip control. And each basic unit of Amplex Swivelites is interchangeable with every other. Arranging new lighting effects is faster, easier, more economical.

For today's outstanding buy, send for the complete Amplex Swielite story!

**Simply write Amplex Corporation, Dept. C-3,
111 Water Street, Brooklyn 1, New York.**

AMPLEX

Sealed-Beam Reflector Lamps, Colorbeam Lamps, Spotlights and Floodlights, Industrial Infra-Red Heat Lamps, Vibration and Rough Service Lamps, Street Lighting Lamps, Traffic Signal Lamps, Incandescent Lamps, Fluorescent Tubes, Display Accessories.

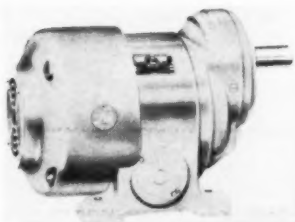


Portable Heater

(27)

Automatic radiant heat for any room in the house is provided by the new Electriglas Dialtemp portable heater. A twist of the dial sets the built-in thermostat. This heater incorporates all the features of the Electriglas radiant heat panels used for complete house heating. It operates on ac. The unit consists of an unbreakable current-conducting glass panel encased in a steel frame, and measures 27-1/2 inches wide, 23 inches high and 7 inches deep.

Appleman Glass Works, Bergenfield, N. J.



Motors

(28)

Announcement has been made of new improvements on "Slo-Speed" geared motors, type FWFA. This new type motor is of the single reduction, "Klosd-Tite" construction for atmospheres containing non-explosive dusts, vapors and foreign materials. An external fan forces cooling blasts of air over the streamlined case. Output shaft ratings are the six AGMA speeds starting at 780 rpm down to and including 280 rpm. Motor is totally enclosed and includes such features as labyrinth seals, heavy duty ball bearings lubricated for life, patented Herringbone rotor, with motor and gears combined in a balanced design from power intake to drive shaft.

Sterling Electric Motors, Inc., Telegraph Rd. at Atlantic Blvd., Los Angeles 22, Calif.

BIDDLE

Instrument News

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

NUMBER 2 OF A SERIES

JAMES G. BIDDLE CO., 1316 ARCH ST., PHILADELPHIA 7, PA.

WHAT THEY SAY ABOUT THE "TTR" TRANSFORMER TURN RATIO TEST SET...

—From Transformer Manufacturers:

"We use this instrument almost continuously 24 hours a day, 5 days per week, and have come to depend on it as part of our production test facilities. Our experience has been that the instrument is accurate, dependable and generally very valuable in our work."

"You will be interested in hearing that your 'TTR' Tester has been doing an excellent job for us."

—From Large Power Companies:

"We like it very much,—don't know how we ever got along without it."

"The 'TTR' Set has proved valuable in making acceptance tests on new transformers and has materially reduced the time involved in testing."

"We have found the 'TTR' Set was successful in detecting a shorted section of



turns in a transformer in operation, which permitted it to be taken out of service before more serious trouble developed."

"We consider the 'TTR' Set one of the most valuable instruments for our transformer work. It saves time and calculations, and gives more accurate results than the other methods we'd been using. Our transformer men depend on the set—so much—there is seldom a day the set is not in use."

The names of these and other companies using the "TTR" Set are available on request. For information regarding this unique instrument, write for Bulletin 55-ECM.

plates, and metallic structures. The method is quick, easy and economical—no calculations or adjustments are necessary—anyone can make tests—direct readings are taken in ohms from the scale and pointer.

Fileworthy literature on the subject of Ground Resistance Testing is available without obligation. Write for Bulletin 25J-ECM which gives instructions and diagrams, or Bulletin 25T2-ECM, "Grounding Electrical Circuits Effectively" by J. R. Eaton.



ONE INSTRUMENT FOR PRACTICALLY EVERY ELECTRICAL RESISTANCE MEASUREMENT

Bridge-Meg Measures a Fraction
of an ohm up to 1000 megohms—

Wheatstone Bridge Included
—Varley Loop Optional

Wherever insulation resistance tests are made, wherever a Wheatstone bridge is needed, this instrument, with its hand-cranked, constant voltage generator is always ready for detecting, diagnosing, and locating electrical faults. Weighing only 15 pounds, this multi-purpose test set is an ideal field tool which quickly pays for itself over and over again.

The Wheatstone bridge is particularly useful in connection with measurements of all manner of coils, resistors and circuits.

The Varley Loop makes possible the location of faults on wires in telephone, telegraph, signal and electrical power systems in industrial plants and power companies.

Electrical modernization programs should include modern measurement and test methods. You should have complete information on this versatile Bridge-Meg Resistance Test Set.

Write for Bulletin 21-60-ECM.

GROUND CONNECTIONS ARE A PROTECTION

... only if they have
low resistance

MEGGER® GROUND TESTING INSTRUMENTS PROVIDE EASY MEANS OF MEASUREMENT

Many seemingly good ground installations offer little protection since high earth resistance renders them ineffective.

There is no assurance that earth resistance will remain constant. It is therefore important that grounds be checked regularly by a reliable, accurate means.

Megger Ground Testing Instruments provide the means in one portable, easy-to-use instrument, for measuring resistance to earth of ground connections, such as rods, pipes, buried



Is Your LITERATURE FILE Up to Date?

James G. Biddle Company
1316 Arch Street, Philadelphia 7, Pa.

Please mail literature checked at right:

- ☐ 55-ECM
- ☐ 25J-ECM
- ☐ 25T2-ECM
- ☐ 21-60-ECM

☐ Complete list of new bulletins

Name _____

Job Function _____

Company _____

Address _____

City _____ Zone _____ State _____

LATROBE

FLOOR BOXES



WIRING SPECIALTIES

PRODUCTS

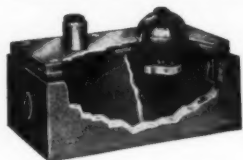
QUALITY

THAT LASTS



No. 470 "Bull Dog" Pipe or Conduit Hanger

Convenient and dependable for hanging pipe or conduit $\frac{1}{2}$ ", $\frac{3}{4}$ " and 1" to steel beams up to $\frac{1}{2}$ " thick. Permits pipe to run at any angle to the beam.



No. 252-R Two Gang Adjustable Floor Box

Neat and practical with No. 200 Receptacle in one section. One Cover Plate has $\frac{1}{2}$ " Bush brass plug; other has 2".

All-Out Convenience! All-Out Performance!

The simple, compact design of "Latrobe" Floor Boxes and Wiring Specialties makes them easy to install or apply. Because only highest quality materials go into their manufacture, they are completely dependable in operation.

Sold Only Through Wholesalers



No. 280 Nozzle with No. 200 Cover Plate

Has 10 Amp. 250 Volt Receptacle in Brass Housing, mounted on $\frac{1}{2}$ " Brass Pipe Extension 3" long. Longer extension if desired.

Keystone Fish Wire

Finest grade flat steel wire in ten sizes, 100, 150 and 200 foot coils.



No. 330 "Tom Thumb" Utility Outlet

Ideal for use in wood floors, baseboards and other installations free from moisture or mechanical injury. Quick and easy to install.



BX Cable Staples



Millions in use all over the country. Packed in cartons, kegs or barrels.

Mercury Lamps

(29)

Announcement has been made of the consolidation of two G-E 400-watt mercury lamps, designated A-H1 and F-H1. The A-H1 lamp has been redesigned to permit its use for street lighting as well as general lighting in industrial plants. F-H1 lamp, which had been recommended for use in outdoor lighting applications, has been discontinued. For street lighting, it may be used in the same way as the old F-H1. It should be burned in a base-up position, within 10 degrees of vertical. With a magnet which holds the arc approximately centered, horizontal burning is approved. The A-H1 lamp produces approximately 15,000 lumens of light, and has a rated life of 4000 to 6000 hours, depending on the number of burning hours per start.

General Electric Company, Nela Park, Cleveland 12, Ohio



Utility Compartments (30)

All-steel utility compartments are available for mounting on standard $\frac{1}{2}$, $\frac{3}{4}$ and 1 ton pick-up trucks, converting it to a service truck. Space for stowing of tools and materials in locked weather-tite compartments. Right side compartment equipped with materials bins and shelf. Compartments are 75 or 85 inches long by 12 $\frac{1}{2}$ inches wide by 15 inches high. Overhead ladder racks with spring hold-downs are available.

Artisan Products, Inc., 3490 West 140th Street, Cleveland 11, Ohio

Load Center Unit (31)

A new "midget" load center unit substation, specially designed for low-voltage, regulated ac lighting and power service in factories and laboratories has been announced. Called an Inductrol power pack, the unit incorporates in one steel housing an air circuit breaker, a dry-type transformer, and an air-cooled induction regulator. The pack, available in either single or three phase ratings, has a capacity

EASILY
INSTALLED

FULLMAN
MANUFACTURING CO.
LATROBE, PA.

ECO-
NOMICAL



ranging from 15 to 100 kva, with incoming circuit rated 480 or 600 volts, 60 cycles, and a regulated output at 120/240 or 208Y/120 volts. In addition to lighting, it can be used to regulate power supplied to resistance heating and infra-red heating equipment.

General Electric Company, Schenectady 5, N. Y.



Oiler

(32)

Announcement has been made of a new "Hypo-Oiler," in pen form designed for fine oiling in the factory, office or home. It has visible oil reservoir. Extra long hypodermic needle makes inaccessible parts reached easily and oiled without damage or smearing. A slight pressure on the chamber will give a light film of oil and more pressure for a drop.

Gaunt Industries, 827 Irving Park Road, Chicago 13, Ill.

Product Briefs

(33) With steps on both ends, two or more people can use the new safety ladders manufactured by Ballymore Company, Wayne, Pa.

(34) Miller Electric Manufacturing Co., Appleton, Wis., has introduced new 10 kva and 20 kva portable "spot" welder, equipped with ball bearing suspension ring. . . (35) A new vacuum gauge with a five-position switching attachment has been announced by Hastings Instrument Company, Hampton, Va. . . (36) Mall Tool Company, Chicago, Ill., has announced a new portable electric impact wrench.

(37) New synchronous and non-synchronous control equipment for low-

SORGEI

AIR-COOLED TRANSFORMERS

Our Deliveries

are longer now on account of increased orders and shortage of critical materials. Also because so many more want

the Best



Transformers

Our usual quick deliveries will be restored when the material shortage is relieved.

We are maintaining our high standards, such as:

Liberal Design for continuous hard service.

Substantial Construction for long life and endurance.

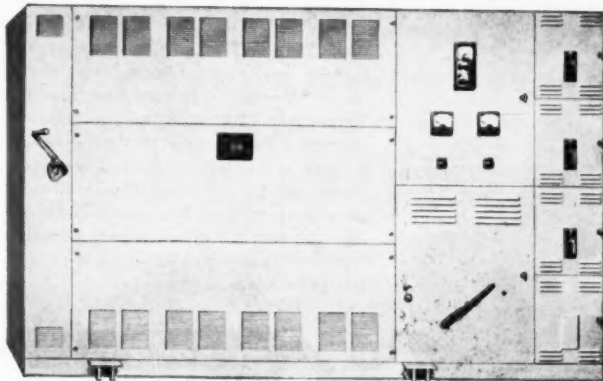
High Efficiency for economical operation.

Conveniently Arranged for easy connecting and simple installation.



1/4 Kv.-a.
Single Phase
460/230 to
115 volt

Sizes up to 2000 Kv.-a. and up to 15,000 volts



1500 Kv.-a. 13,200 volt unit sub-station, with primary disconnect, secondary metering, main and branch circuit breakers.

Sales Engineers in Principal Cities

SORGEI ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Air-Cooled transformers

tame the most stubborn nuts as the experts do

with
famous
*
Snap-on
BOXOCKETS



BOXOCKETS come in full size range—in Standard, Dwarf, Midget designs and in Extra Heavy-Duty types.

SNAP-ON TOOLS CORPORATION

8048-C 28TH AVENUE
KENOSHA, WISCONSIN

* Snap-on is the trademark of Snap-on Tools Corporation.



capacity, spot-type resistance welding machines is available from Westinghouse Electric Corp., Pittsburgh, Pa. . . . (38) Ideal Industries, Inc., Sycamore, Ill., has announced the new Blo-R-Vac, all-purpose tank-type cleaner for industrial and commercial use. . . . (39) Erico Products, Inc., Cleveland, has introduced a new caddy ground clamp, 500 ampere capacity.

(40) A new oil well pumping control featuring new design in magnetic starter, overload relay, motor disconnect switch and lightning arrester, has been announced by General Electric Co., Schenectady, N. Y. . . . (41) Rol-Away Truck Co., Portland, Ore., has introduced a new hand truck, called "Stock Picker", designed for easy assembling and carrying of small parts, supplies and packaged goods.

(42) Wright Hoist Division of American Chain & Cable Company, Inc., Bridgeport, Conn., has announced a new line of "Frame B" speedway electric hoists. . . . (43) Lowell Metal Products Corp., St. Louis, Mo., has introduced "Powr-Driv" projectors for use in stadiums, parks, sound trucks, railroad yards, ship yards, etc.

CATALOGS and BULLETINS

(44) GROUND TESTING instruments for measuring resistance of earth to ground connections and for measuring earth resistivity are discussed, pictured and specified in bulletin 25. James G. Biddle Co.

(45) RIGID CONDUIT installation hints is subject of publication 18-90 containing instructions and step-by-step line drawings. General Electric Co.

(46) CIRCUIT CALCULATOR is pocket-sized slide rule with scales for 3-phase circuits, power factors, length of circuits in feet and other useful data. Descriptive folder available from Van Halst Calculator.

(47) TONG TEST AMMETERS for instant current measurements, ranges from 50 to 1000 amps, are discussed in 8-page 2-color folder TT5025. Columbia Electric Mfg. Co.

(48) WOOD WEDGES in many shapes, styles and dimensions are specified in bulletin 280. Insulation Manufacturers Corp.

(49) PLASTIC PIPE for electrical uses of many kinds, with the advantages of flexibility, resistance, economy and lightness, is discussed in 8-page brochure. Johnson Plastic Corp.

(50) **LOAD CENTER** with panelboard features, from 40 to 100 amps, 1 to 20 circuits, for residential and commercial applications is discussed in bulletin TEB-12. Trumbull Electric Mfg. Co.

(51) **ADEQUATE WIRING ANALYSER** with direct reading scale to indicate safety of cable installed is described in form PF600. Sprague Electric Co.

(52) **PIPE AND BOLT** machines and power drives for cutting, threading and reaming, are subject of pocket-size folder form PM150. Beaver Pipe Tools, Inc.

(53) **RESONANT REED TACHOMETERS** for hand use or permanent mounting are pictured, priced and specified in 16-page 2-color bulletin 31. James G. Biddle Co.

(54) **PHOTO LAMP DATA** booklet contains information on correct photographic exposures, film and shutter speeds, various reflector finishes and other useful shutterbug info. General Electric Co.

(55) **MILL MOTORS** and auxiliary controllers are discussed in booklet B4730 having sections devoted to armatures, bearings, field coils, brush holders and ventilation. Westinghouse Electric Corp.

(56) **FORMED FIBER WEDGES** for motor slots are pictured and specified in bulletin sheet 441. Insulation Manufacturers Corp.

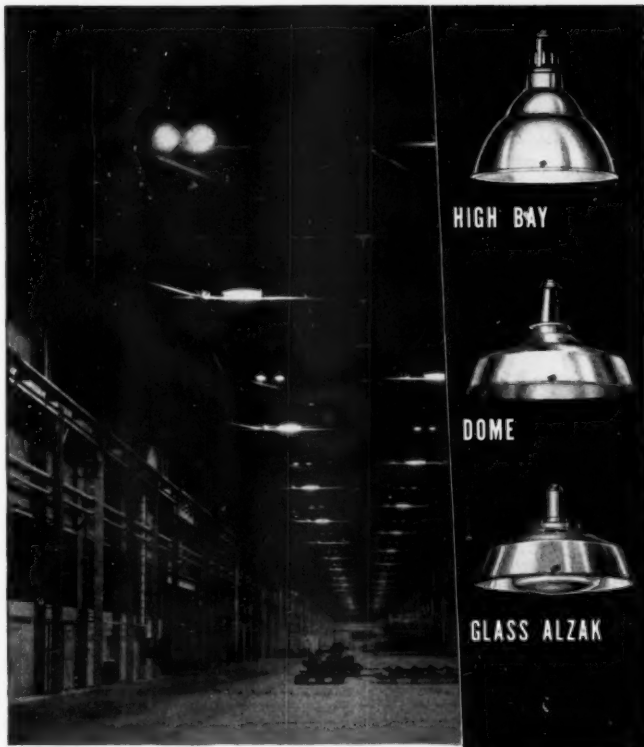
(57) **SWITCHES**, single pole, double throw, ac, with several amp and volt ratings are priced and described on 2-color file sheet. Simonds Machine Co., Inc.

(58) **OIL CIRCUIT RECLOSURE** maintenance procedures are illustrated and described in 12-page bulletin 50025. Line Material Co.

(59) **SYNCHRONOUS GENERATORS** with ratings from 1.875- to 50-kva and frequencies from 60- to 400-cycles for standby, prime-source or portable power are discussed in folder GEA 5470. General Electric Co.

(60) **TUBULAR STEEL SCAFFOLDS** for industrial and commercial installation and electrical maintenance work are pictured in bulletin PSS 24, showing erection techniques and various styles of construction. The Patent Scaffolding Co., Inc.

(61) **AIR CONDITIONING** for military applications and industrial uses is sub-



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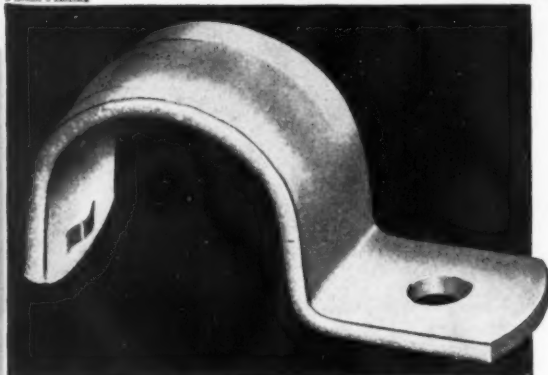
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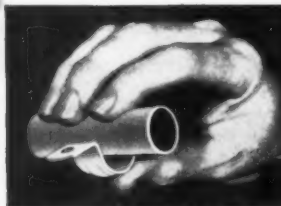


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(62) **POWER PACKS** for ac lighting and power service, 15- to 100-kva capacity, incoming circuit 480- to 600-volts, output 120/240 or 208Y/120 volts, are described and illustrated in booklet GEA 5571. General Electric Co.

(63) **STRIP CHART** recorders, electronically operated are discussed in bulletin C2-2 which includes data on direct deflection, Wheatstone bridge and pneumatic control related to capacitors. Wheelco Instruments Co.

(64) **SWIVEL LIGHTING** housings with variety of ornamental metal reflectors, louvers, leases, flexible arms and bases are subject of AIA file 31F2. Litecraft Mfg. Corp.

The following items may be secured only by writing directly to the various manufacturers on your company letterhead. Please do not use the Readers Service Card for these publications.

TERMINALS AND CONNECTORS, including pressure ring, tongue and flat type fasteners, insulators, joints and tools, with specifications, descriptions and application data, are subject of 40-page bulletin No. 61 prepared by The Thomas & Betts Co. Inc., Elizabeth 1, N. J.

FANS for offices, homes and commercial buildings, of the pedestal, window, wall or ceiling-mounted types, oscillating or fixed air paths, in a wide range of speeds and capacities, are discussed in 30-page 3-color catalog released by The Emerson Electric Mfg. Co., Saint Louis 21, Mo.

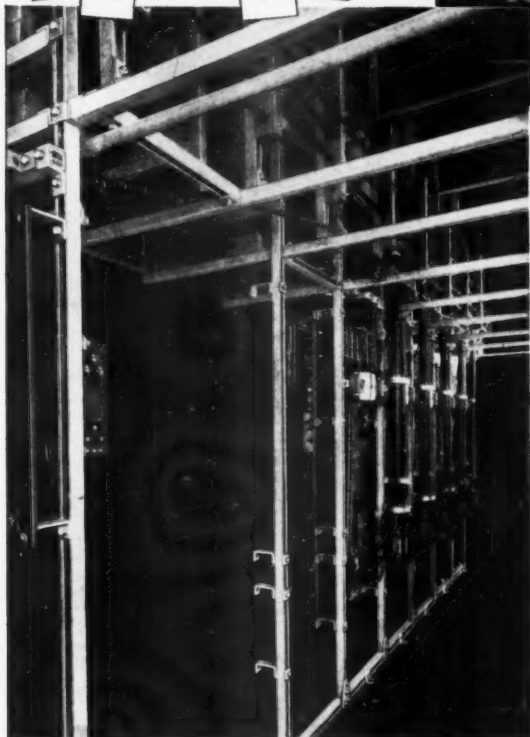
PHOTOTUBES, cathode-ray tubes and special tubes are cataloged in an easy-to-read form in booklet CRPS-102-A, consisting of 20 pages and including more than 150 tube types such as phototubes, UHF and others for special application. Description, ratings, dimensions, wiring diagrams and operating characteristics are included. Price 15 cents. Radio Corporation of America, Tube Department, Harrison, N. J.

ALUMINUM DATA BOOK is 194-page publication containing data on alloys, tempers, sizes, physical and chemical properties, production limits, finishes, corrosion resistance and other useful information for users of aluminum. Reynolds Metals Co., 2500 S. 3rd St., Louisville, Ky.

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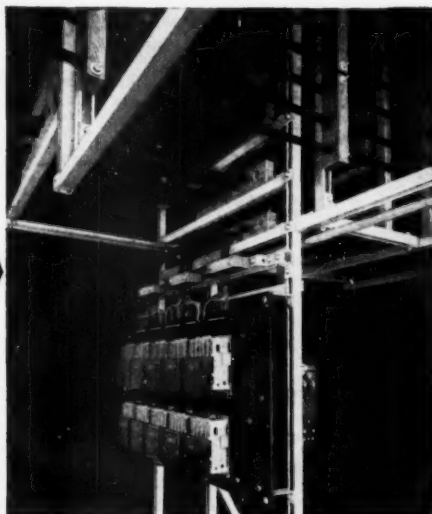
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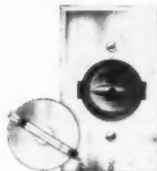
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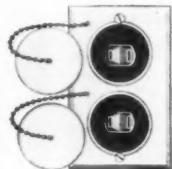
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Minneapolis, Minn.

and

B. A. McDONALD
Chief Inspector
New York Board of Fire Underwriters
Rochester, N. Y.

Questions on the Code

Gasoline Pump Disconnects

Q. I recently installed a circuit breaker panel to protect the circuits running to gasoline pumps of a service station. The voltage of the circuit was 110 volts and a breaker was placed in both the live wire and the ground wire of the circuit, in order to satisfy Section 5142 c of the Code. The breakers are connected together so that they can be tripped manually at the same time. Is there any Code violation in this set up?—D.L.

A. It appears to me that the above installation is in violation of Section 2409 a of the Code. This Section does not permit an overcurrent device to be placed in the grounded conductor unless the operation of same would open both conductors of the circuit. With thermal operated breakers it would be possible, due to a fault, to open the ground wire and although the circuit appears to be dead, we would have voltage on the live wire at the pump. In order to satisfy rule 2409 a it would be essential that the breaker be so designed that both sides of the circuit be simultaneously disconnected when a fault occurs.—B.A.McD.

Type T Insulation

Q. It has recently been brought to my attention that it is now permissible to use Type T insulation on conductors of the circular mil sizes when placed in metallic raceways. I cannot understand this as my copy of the Code definitely provides that conductors over 4/0 if of the TW or T type cannot be placed in metallic raceways but must be run as open conductors. I therefore will appreciate your advising as to whether this is simply a permission granted for the duration of the shortage brought on by this war emergency, or is the National Electrical Code actually being revised?—I.P.

A. The revision which is just recently off of the presses for the 1947 edition of the National Electrical Code no longer contains the provision which prohibits the use of circular mil sizes of Types T or TW

insulated conductors being used within metallic raceway systems. This change therefore is not a temporary affair made for the duration of the emergency, but is instead based on experience as presented to the Code Committee.

Inasmuch as this insulation is a thermoplastic material and is subject to cold flow, it is considered advisable to be most careful in determining the ambient temperatures of the areas in which conduit runs may be extended and to guard against any sharp turns where undue strain may be placed against the insulation.—G.R.

Close Openings In Boxes

Q. I recently installed a large pull box in the basement of a school building. Due to an error a 10 ft. length of 2 inch conduit was connected to the box and never used. The inspector made me take it out. Was there a Code violation?—F.J.

A. Section 3712 of the Code requires openings in boxes to be closed and I believe it should apply to the case you cite. A few years ago on reinspection work I removed the cover of a large pull box and found a rat nest inside with several of the conductors chewed to a point where a fault might occur. Since all K.O. holes were closed I was unable to understand how the rats entered the box to make the nest. Further investigation showed, however, that a 2 inch conduit run entered the box similar to the one covered by your question. This was the answer to the rat nest and how the rats obtained access to the pull box. This condition could have resulted in a serious electrical fire. The innocent K.O. hole may be a very important factor towards a safe electrical installation.—B.A.McD.

High Voltage Service

Q. In a school, the contractor starts with conduit from the top of a 50 foot pole then down underground runs 50 foot to the building, through a wall and sets a junction box

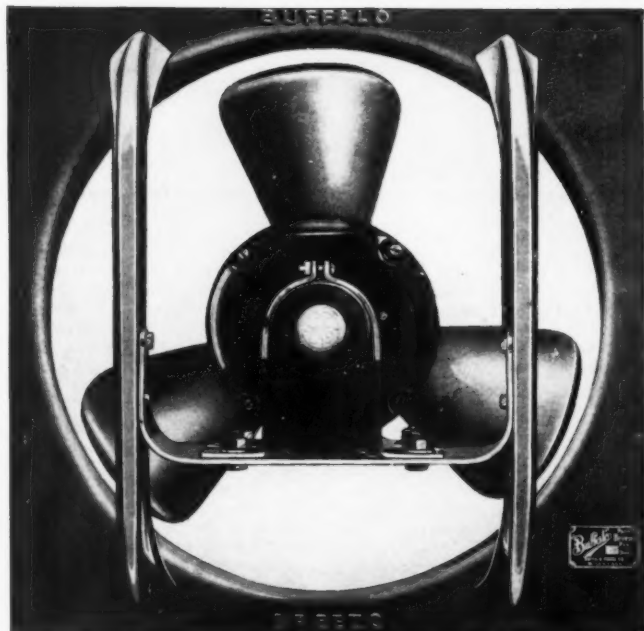
in a crawl space under this building. From this junction box, conduit extends up four feet to the bottom of steel joists and the conduit is secured to same for a distance of approximately 200 feet before the disconnect is set in a vault. The voltage is 2300 and the line protection is fused at the top of the pole.

We contend the disconnect should be at the entrance of the building or just outside of the building and readily accessible. A breakdown in the conductors in conduit secured to the bottom of steel joists could be disastrous and fuses at the top of pole are not accessible (only to linemen).—A.J.H.

A. Since the voltage of this service exceeds 600 volts, Code rules 2386 through 2392 apply. Reference to Code Section 2386 shows that many of the rules for low voltage services apply to services over 600 volts. It is noticeable, however, that Section 2351 which covers the service disconnect and sections 2371 and 2372 which cover service overcurrent protection, do not apply to services over 600 volt. A review of Section 2386 through 2392 shows that Section 2388 covers the disconnecting means which concerns our problem. This Section by reference to Section 2351 implies that the service in question must meet the requirements of Section 2351. If this is correct the question of what rules apply would have been clarified if Section 2386 included Section 2351.

Assuming the above reasoning to be correct, Section 2351 applies to our service and in line with Section 2351 A, the service disconnect must be located "at a readily accessible point nearest to the entrance of the conductors, either inside or outside the building wall." According to this rule it is my opinion that the disconnect in question should have been located where the conductors entered the building or immediately outside, and provisions made to assure such a location to be adequate and accessible for the proper manipulation of the switch. Another method, in line with the last sentence of Section 2387 would have been to enclose the 200 ft. run of service inside the building in 2 inch of concrete or brick.

Section 2372 recognizes the location of the service overcurrent device at



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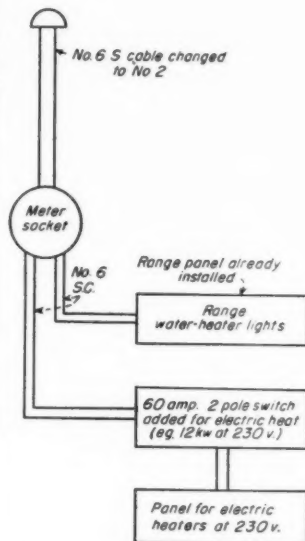
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the outer end of the service raceway. In line with the first paragraph of this reply this rule is not recognized for services exceeding 600 volts.

It is my opinion that the present installation is hazardous and is not in line with the objectives to be attained when the rule was written. You have 200 ft. of a 2300 volt service run inside the building with no means of control and a question regards the overcurrent protection. I once saw a fire which occurred in a service meter box ahead of a main switch and experienced the frustration which results when you can't do anything about it.—B.A.McD.

Service Installation

Q. Would an installation as shown in sketch below be approved?
—T.H.



A. I would criticize the use of two No. 6 service cables run from the meter socket to the service equipment. The No. 2 cable should have been continued direct to the service equipment. The design of meter sockets is such that provisions for handling only one cable connection is provided and the method you have used can only result in undue congestion of the wires at this point. Your method also involves the use of more unprotected service cable than the ordinary method, which is undesirable. I assume that two conductors were connected to one terminal and according to Section 1117 of the Code, this

may not be done unless the terminals are approved for such a connection. It also appears that Section 2305 of the Code might be involved. This Section of the Code intends to keep at a minimum any splices or connections in the service conductors from the point of attachment at the service drop to the connection at the service equipment.—B.A.McD.

Common Enclosure for High and Low Voltage

Q. On a 125 hp motor, 2300 volts, with slip ring controller, the high voltage and drum controller wires enter same enclosure. Is this a Code violation and unsafe?—C.W.K.

A. Section 3011 of the Code covers this point. This section, in part, says "Conductors of light and power systems of over 600 volts shall not occupy the same enclosure with conductors of light and power systems of 600 volts or less." The next sentence of this rule eliminates this requirement when control conductors used in connection with any motor or starter are involved. Irrespective of this Code ruling I believe the high and low voltage wires should be separated so that they do not cross one another, unless high voltage insulation is used on all conductors.—B.A.McD.

Figuring Size Of Main Service Conductors

Q. I recently installed a service consisting of a 200 ampere main switch No. 2/0 RH service conductors and 175 ampere main fuses. The No. 2/0 service conductors with a 175 ampere current carrying capacity more than satisfied the load to be served. The local Inspector has criticized this installation on the basis that the service conductors must have a current carrying capacity at least equal to the rating of the main switch. Will you kindly advise what rule in the N.E. Code warrants this criticism.—H.W.B.

A. There is no Code rule which requires service conductors to be at least as large as the rating of the main service switch. According to Section 2357 a service switch shall have a rating as required by Section 2203, which gives all the details to be followed in determining the size of the main switch. According to Section 2304 the size of the service entrance conductors are also figured in line with the requirements of Section 2203.



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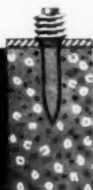
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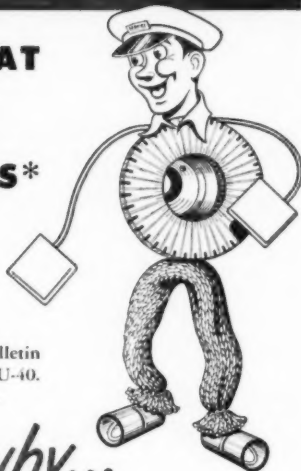


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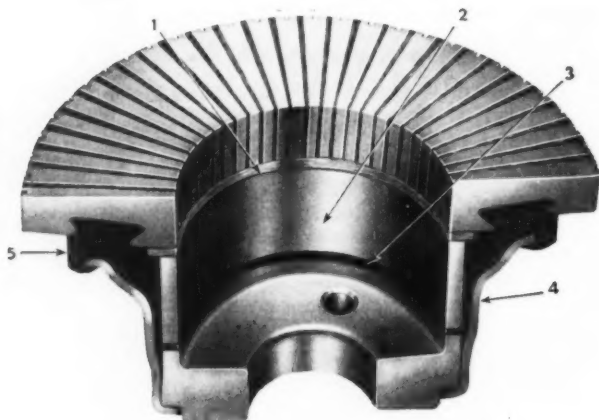
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According to the Code many combinations may result where the main switch will be larger than the service entrance conductors and there is no violation. It also follows that some engineers in the interests of adequacy or future expansion specify the service conductors to be as large as the service switch and experience shows that such procedure has in many cases justified the additional expense involved.—B.A.McD.

Grounding Three Phase Systems

Q. What advantage would it be to ground one phase of a 440 volt, 3 phase Delta connected circuit?—C.W.K.

A. Section 2511 of the N.E. Code tells us that circuits are grounded for the purpose of limiting the voltage upon the circuit which might otherwise occur through exposure to lightning or other voltages higher than that for which the circuit is designed; or to limit the maximum potential to ground due to normal voltage. Wiring systems which are supplied through step-down transformers may be exposed to high voltages due to insulation failure within the transformer and they may be exposed to high voltage due to a cross between the primary and secondary conductors. When such failures occur, the 600 volt insulation on the secondary conductors breaks down with the result that fire and personal injury hazards result. When such systems are grounded, however, excessive increase in voltage to ground is eliminated when such faults occur and the fire and personal injury hazard is minimized.

My experience as an Inspector indicates that an ungrounded three phase system either 220 volts or 440 volts unless maintained in good condition presents both fire and injury hazards when

an accidental ground occurs on one phase. I can cite many cases where two or more customers are connected to the same ungrounded three phase distribution system where a ground fault in one building introduces a hazard in the other buildings particularly when another phase becomes grounded. During the past year a fire occurred in a factory served by a three phase 220 volt ungrounded system. The transformers serving this factory also served an oil company across the street. Within ten minutes after the factory fire was extinguished the oil plant service was on fire. Investigation showed that an accidental ground existed on the service equipment at the oil plant and when the fire occurred in the factory across the street another phase became grounded and the resultant short circuit caused the second fire in the oil plant. If the secondary system had been properly grounded the second fire would not have occurred.—B.A.McD.

Wire Approved for Wiring to Gas Pumps

Q. Is all Type TW approved for use in service stations, bulk plants and refineries, or just G.E. Geotrol as advertised?—L.J.H.

A. Assuming that you are concerned with conductors which will be exposed to gasoline the ordinary TW conductors are not approved by Underwriters Laboratories for such use. However, the U.L. have recently approved a Type TW, transparent nylon-jacketed wire where exposed to gasoline at maximum temperature of 30° C. This conductor satisfies the requirements of Section 5142 of the Code. It may also be used in moist locations and where exposed to mineral oil. This conductor is made by the General Electric Co. and may be identified in some cases with the wording "GECO" or "GE" stamped at intervals on copper of solid conductors.—B.A.McD.

Grounding Portable Equipment

Q. Prior to enactment of an ordinance requiring conformity with the National Electrical Code, it was common practice to ground portable equipment as shown in the diagram. The building is an industrial establishment and all circuits are run in conduit. Three prong receptacles are used and the tools are wired with three



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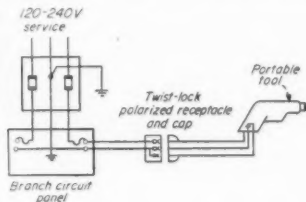


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conductor flexible cable. Two wires are run from the branch circuit panel and the neutral wire is jumped to the ground terminal of the receptacle. I contend that either a separate conductor be run for grounding purpose only or the grounding terminal of the receptacle be connected to the outlet box. I claim that the use of the grounded branch circuit conductor for grounding is a violation of Section 2561, article 250 which states that "the grounded circuit conductor on the load side of the service shall not be used for grounding equipment etc.—H.I.S.



A. You are correct in your contention that the method shown on your sketch for grounding a portable tool is in violation of Section 2561. Since the circuit is run in conduit, the proper procedure is to use this metallic path to ground for grounding the equipment. This is usually satisfied by connecting the equipment ground terminal of the receptacle to the receptacle box.—B.A.McD.

Demand Factor on House Heating

Q. Would you give me the demand factor required by the Code for figuring service entrance installations used in residences when electric heat is used. I hear some use 80% of total heat load plus regular residence load.—T.H.

A. It is the opinion of the undersigned that the N. E. Code does not cover any demand factor which is definitely concerned with electric house heating. Section 2203E of the Code however, might be interpreted to apply since this rule specifies a 75% demand factor may be applied to fixed appliance loads when installed in single or multi-family dwellings in addition to range installations. I believe, however, that there was no consideration or intent that this Code rule should apply to complete electric house heating installations. Arriving at a correct demand factor for such installations involves many important factors, some of which are variable due to the heating design, house construction, or the location of the property to



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be heated. The manufacturers of such heating systems have considerable data on this matter and make recommendations regarding demand factors which have been recognized by some Inspectors. I do believe, however, that as field experience continues to grow that the Code will be able to cover the matter adequately.—B.A.McD.

Aisle Lights in Theaters

Q. What Code rule applies to aisle lights in a theater? How many may I place on one circuit?—M.A.

A. Section 2116 of the Code tells us how to compute the number of circuits required for general lighting on the basis of watts per square foot for specified occupancies or on the basis of one and one half ampere per outlet for other occupancies. According to this Section of the Code, 2116B, each aisle light must be figured at 1.5 amperes. This would only permit 10 outlets on a 15 ampere circuit without considering a further penalty which appears to be in the picture due to the continuous use of such outlets.

Due to the fact, however, that aisle lights are of low wattage and so designed to prevent the use of larger lamps, many Code authorities believe that Section 2116 of the Code should not apply to such special lighting and permit the number of outlets to be based on the wattage of the lamp to be used. You should, however, consult your local Inspector before taking such action. This question should be clarified by the Code.—B.A. McD.



W. PHILLIPS ROBBINS, boss of Central Electric Co., in Salt Lake City and president of the Utah Chapter, NECA, is doing work on micro-wave relay stations in addition to his commercial and industrial electrical construction projects.

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5025-SLR



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NO. 5025-SLR—BEAMED LIGHT is provided by the lens in the cage end. Phenolic plastic handle has convenience outlet and Levolver switch. Adjustable reflector, No-Rol cage, hanging hook, 25 feet red thermoplastic cord.

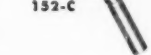
NO. 3006—Designed to provide absolute protection wherever portable lighting must be water tight, dust tight and moisture proof. Handles are macerated plastic, sealed at the cord end with a diaphragm washer. Heat and impact resisting glass globe, screws into rubber gasket, seals globe airtight.

NO. 5000 SR—features the new, approved 15 Amp. 125 Volt convenience outlet molded-in the phenolic plastic handle. Provides on-the-spot power source for tools, etc. Closed end cage.

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152-C



NO. 152-C—Adaptable Lamp Changer for 100 Watt bulb. Changer heads are available for other types and sizes of bulbs. New light weight steel pole is furnished in 5½ foot sections insulated and easily locked together to reach up to a recommended limit of 30 feet.

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ALL day long, waves of Arab horsemen beat upon the ranks of Charles Martel's veteran militia. But time after time, the enemy cavalry recoiled before storms of iron-tipped javelins, their shining scimitars unsuccessful. On the second morning, the Saracen leader, Abderrahman, was slain, pierced with many spears. The Moslem horde fled back across the Pyrenees, never again to menace the Western world.

Time after time, as at Tours in 732 A.D., Christian civilization has been threatened by seemingly invincible enemies. Yet history proves that victory invariably has gone to the nation or alliance which excelled in the production and use of iron and steel.

In the present era of alarms and crises, it is

reassuring to realize that America has greater capacity for making steel than all the rest of the world combined. Furthermore, the American steel industry is expanding at a rate far faster than that of all the dictator-directed economies behind the Iron Curtain. Our free and independent steel making and metal working industries can and will forge sinews for the peace we want or for the war we may be forced to fight.

So remember this: It is not only the threat of Muscovy to fear—America has itself to fear also—its misguided sentimentalists, its sheltered saboteurs—who seem to play communism's game by frittering away our strength and our resources.



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Reader's Quiz

Splicing Cable For Use Underground

QUESTION Q-17—When splicing a 2300 volt primary cable, 3 conductor, No. 4, cambric 5000 volt insulation, lead covered, in an electric man hole, below ground surface, isn't it customary and the generally accepted practice to carefully pour an approved cable compound in the completed wiped lead sleeve to drive out the moisture and air?

All my reference data seem to stress the proper pouring of an approved compound.

Recently a splice in such a cable was made in this locality by a cable splicer, and the lead sleeve was not filled with any compound.

I maintain this job was not done right, and is not a good reliable long life job, because there is moisture and air in the lead sleeve.—G. F.

ANSWER to Q-17—It seems that there is room for heated discussion both pro and con on this question. I maintain that pouring ozite or some other equal insulating compound is definitely not necessary. If the joint is made properly and properly wiped, there should be no more moisture collecting between the lead sleeve and the insulation than it would between the lead sheath on the cable and the insulation. In order that the joint is properly made, the lead sleeve should be no larger than is necessary to slide over the insulated joint. Before sliding the sleeve over the finished joint, if a little "Desicant" is sprinkled over the splice, this will absorb any moisture that would be liable to accumulate. When wiping the ends of the sleeve great care must be made that the wiping solder is the right temperature to assure a good nonporous joint. This can be determined by the appearance of the wipe; if it appears dull it is a porous joint commonly referred to in the trade as "snowball". If the wipe is shiny, it can be considered a good tight job.

When pouring ozite or other insulating compound into a finished joint, great care must be taken that the compound is the right temperature. If it is too hot, it would burn the insulation and also foam up and leave bubbles inside the sleeve. On the other

hand, if it is too cool, it will not fill in all the crevices inside the sleeve.—F. S. M.

ANSWER to Q-17 — It certainly should be the practice to pour an approved compound in the completed wiped lead sleeve over the properly made and insulated splice in a 2300/4000 volt cable in a manhole or elsewhere. Care should be taken to fill all voids so as to eliminate moisture and air. Leaving air or moisture will increase the chance of breakdown due to the higher dielectric gradient and the possible deterioration of the insulation.

Section 1118 of the National Electrical Code provides that: "All splices and joints and the free ends of conductors shall be covered with an insulation equal to that on the conductors" and an explanatory note states that: "A covering protecting a splice or joint needs only provide insulation on the conductor to the same extent that the original insulation is a safeguard against the effects of voltage, temperature, moisture, etc."

Where the outer sheath has been broken, additional protection at the splice will be needed to provide the safeguard equal to that given by the original construction.

Rule 261-G-1-(c) of the National Electrical Safety Code has about the same requirements which read:

"(c) Cable Splices. Splices in the cable shall be made so that their insulation is not materially weaker than the remainder of the cable. The sheath or armor at the splice shall be made electrically continuous."

Experience shows that omitting the compound often results in failure, especially if moisture is present.—J. E. W.

ANSWER to Q-17—The purpose of insulating compound in a cable splice is to:

1. Eliminate excessive moisture and air in a pocket between tape and lead.
2. Serve as an additional insulation of a cable.
3. Fill voids in a pocket between cable and lead.
4. Provide good foundation for lead sleeve.
5. Add mechanical strength to a joint.
6. Make cushion against mechanical shocks.

7. Make solid mass out of finished splice.

8. Keep tape from unwinding and drying.

The design, as used in industry today, is a result of long series of experiments and is well justified by long experience. Splice made in accordance with the standard procedure, in general, gives satisfactory connection both from mechanical and electrical standpoints of view.

Variations from this procedure may not be damaging and mortal to the life of a cable splice and under favorable conditions may last for quite a long time, but adherence to recommended procedure can be considered good insurance against troubles.—W. J. P.

ANSWER to Q-17—The possibility of failure in a 2300 volt, 3-conductor cable joint with cambric insulation and lead covering, which has not been "boiled out" with hot compound and left completely filled is always possible for the reasons given, moisture in the entrained air and on the surface of the tape giving rise to leakage and eventual breakdown. When the insulation has been completed and the lead sleeve adjusted to its final position and "wiped" to the lead covering the "boiling out" and filling must be carefully done at the correct temperature recommended for the compound used and the process continued until no traces of air bubbles are indicated and the level of the compound in the sleeve be kept to a point assuring complete filling. With the pouring opening say $\frac{1}{4}$ inch higher than the discharge opening, the progress of the work can be carefully watched until finally the joint is completely filled.—C. O. D.

Low Voltage AC Loads

QUESTION Y-15—Why are shunts not used on low voltage ac loads? Also, voltmeters direct, without transformers.—A. H. J.

ANSWER to Y-15—In alternating current circuits, a shunt may be used on an ammeter or a series resistance with a voltmeter. However, the results are useful only for steady state conditions and require the use of calibration factors found by test.

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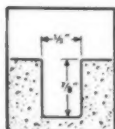


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When you find it necessary to fasten objects such as machinery, shelving and electrical equipment to solid floors, walls and ceiling, you can save yourself time and trouble by using Paine Expansion Screw Anchors No. 900 (screws are not included). These anchors are quickly set in place to make a permanent anchorage that is capable of supporting up to 10,000 lbs., depending on the size used. They can be used in stone, marble, concrete or any other solid material. They are rust proofed and vibration resistant. A Setting Tool comes in every box. The anchors are stamped with size and thread of bolt or screw to use and have a directional arrow identifying which end goes in the hole.

Use a Paine Sudden Depth Rotary Drill bit for quick, accurate holes or, for the occasional user, use a Paine Hand Hammer Star Drill.



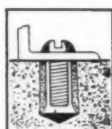
*For the Paine 1/4-20 drill a 1/2" hole, at least 7/8" deep.



Place the anchor in the hole with the arrow on the anchor pointing down.



Place set tool on anchor and pound until anchor is set.



Screw the object to be anchored as tightly as possible.

*Dimensions in first illustration apply to Paine 1/4-20 only.

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Hanger Iron, perforated
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WRITE FOR CATALOG

Shunts and resistors are nearly non-inductive. A meter is inductive, usually to a high degree. No matter how used, the meter is sensitive to the voltage drop across its terminals.

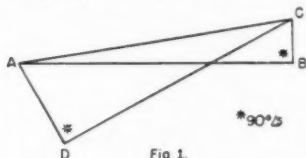


Fig. 1

Fig. 1 is a voltage diagram of two circuits in parallel, neither having the same ratio of resistance to reactance. AC is the voltage drop across the combination, which is equal to the current times the combined resistance and reactance. AB is the resistance drop in the shunt and BC is the reactance drop. AD is the resistance drop in the meter and DC the reactance drop. Need for test calibration should be apparent. Any meter also, when used with a shunt, will not fully respond to load fluctuations. The variations in current will tend to favor the nearly non-inductive path of the shunt. This is true to some extent in direct current measurements, but is especially true with alternating current.

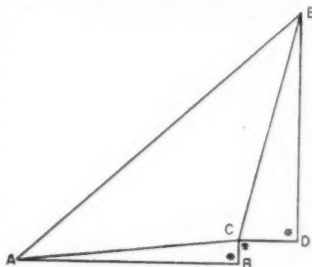


Fig. 2

Fig. 2 is a voltage diagram of a meter and "multiplier" in series. AB and BC are the resistance and reactive drops of the series resistor. CD and DE are the same drops, respectively, in the voltmeter. AE is the circuit voltage. Unless there is test calibration data, the meter readings will be misleading. Also, the inherent inductance of the circuit will tend to "damp" close response to voltage fluctuations.

It might be argued that a series capacitor in the voltmeter circuit would neutralize the inductance. This is a complex problem which depends upon the magnitude and frequency of the fundamental, together with any harmonics that might be present. If resonance could be secured, it would be found that the voltage components present—even if their vectorial sum was low—might exceed the insulation limitations of the circuit.

Alternating current instruments are made which have characteristics enabling them to be used in the manner of direct current instruments, but they are not generally used on ordinary power circuits.—L. E. B.

ANSWER to Y-15—In a direct current installation, the ammeter, leads and shunt are calibrated together in order that the ammeter shall receive a definite share of the line current, which divides in inverse ratio to the shunt resistance and the combined resistance of the ammeter and leads.

If such an arrangement were used on an alternating current system, the current division would depend on the impedances of the two paths, rather than on their resistances. As the resistances of the shunt and leads are quite small, the impedances will be affected strongly by changes in the reactances, which will be influenced by the proximity of conducting bodies, and by the configuration of the leads themselves as installed. This will render the ammeter reading unreliable.

As to the use of ac voltmeters without potential transformers, that is frequently done on circuits on which the voltage is not too high.—B. F. S.

Can you ANSWER these QUESTIONS?

QUESTION Y17—At our plant we connected a $\frac{3}{4}$ hp., 3 phase, 220/440 volt motor to a reversible starter. Line voltage at 440 motor was wound 2 parallel star.

When the motor was started under partial load, it had about 50% or less its starting torque in one direction. In the opposite direction, it would start only by removing all of the load.

After disassembling and examining the winding, it was discovered that 2 opens were in the 2-5 leg of the winding. The growler indicated several shorts, throughout the stator.

Why should this motor have this peculiar behavior—more torque in one direction than the other?—C. L. S.

QUESTION A18—The use of capacitors has increased to enormous proportions among rural cooperatives in this region of ample TVA hydro power and with them have come problems quite new to rural line engineering.

Many of the roads are as crooked as the proverbial dog's hindleg and are none too wide nor well marked, hence our outages chargeable to collisions are many. With delta connected capacitors in a four wire wye system, we are really "sitting ducks" for the occasion when a phase fault may cause serious resonant overvoltage with most dam-

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BETTER BALANCED

And every Monarch fuse is "better balanced" . . . to provide you with the safest electrical protection possible. This important feature means that you are fully guarded from two possible fuse faults . . . over protection (excessive lags with resultant burned out equipment) and under protection (faulty fuses that burn out at less than specified loads). More and more responsible people in industry are realizing the value of "better balance" between these two extremes and the value of Monarch fuses in providing sound, safe protection. So specify . . . and insist on Monarch Fuse, — the fuse with the exclusive, fully approved MONO-LAG link. There's a dealer near you, — write for his name.

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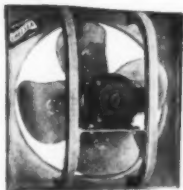
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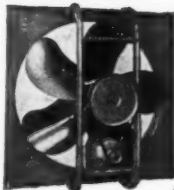
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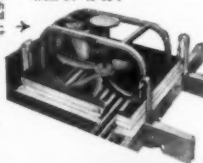
Designed for attics or low headroom, this Chelsea package unit is complete with automatic ceiling hanger, brackets and springs, canvas boot, etc. Quiet in operation, economical to install. Sizes 24" to 48".

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aging results to the connected load; primarily lamps and motors.

The hot stove league debate has it that should a single phase failure occur, the intact phase would have a transformer and capacitor in series between it and the neutral. With a second wire open, the single remaining line would energize both since the aforementioned series arrangement of transformer primary and capacitor bank would be established on the normally "dead" phase.

When this occurs, things happen as evidenced by a recent failure far out on the extremity of a line that brought the signal men of the L & N Ry. Co. out on the next train. TVA alternating current was flowing in the rails in such volume as to completely upset the train signal system.

The answer appears to be not too remote. The idea is to connect the capacitors in wye and to tie its junction to the neutral.

Any comment, readers?—P. C. Z.

QUESTION B18—Recently I installed a single 40 watt fluorescent fixture and it worked O.K. After about 30 days, it refused to work, and I found out that the two coils were bucking each other.

Did some one change the ballast, or was there a chance that the light could have worked this way for 30 days?—H. S.

QUESTION C18—When placing the fuses in the fuse blocks of a branch circuit, (550-440 or 220v, 3 phase) with no load on the circuit, I notice a slight arc between the fuse and fuse-block contacts when placing the 2nd and 3rd fuses in. What causes this arc?—A. R.

QUESTION D18—Is there any way to determine when an ionodic rod should be renewed in an electric water heater without removing it at intervals?—R. E. L.

QUESTION E18—Three phase squirrel cage, star or delta connected motors, dual voltage, nine leads. (440-220 volt in particular.)

Is there a simple method of definitely identifying terminals, in case of error or loss of markings?

Without dismantling motor.

Without running motor.

Without requiring a large power supply.

110 and 220 volt 60 cycle single phase, and 440 volt three phase available; but not 220 volt three phase.

Ammeter, voltmeter and ohmmeter available.—B. F. W.

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YOUR ANSWER BY APRIL 15**



For Trouble Free Installations see that your motor starters carry this Mark of Quality Control

Quality is built into Allen-Bradley Motor Starters in three ways:

- 1—There are no trouble making gadgets, like pins, pivots, hinges, bearings, or jumpers.
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3 OR 2 PHASE	110V	7 1/2
	220V	15
	440-600V	30
SINGLE PHASE	110V	3
	220V	7 1/2

CONNECTIONS FOR THREE OR MORE PUSH BUTTON STATIONS

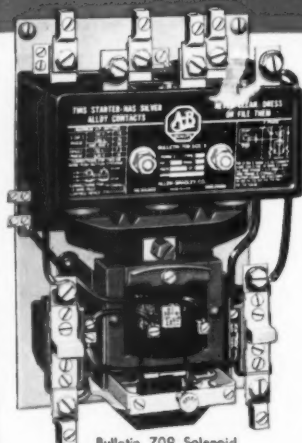
19 START 20 STOP 21 STOP 22 STOP 23 STOP 24 STOP 25 STOP 26 STOP 27 STOP 28 STOP 29 STOP 30 STOP 31 STOP 32 STOP 33 STOP 34 STOP 35 STOP 36 STOP 37 STOP 38 STOP 39 STOP 40 STOP 41 STOP 42 STOP 43 STOP 44 STOP 45 STOP 46 STOP 47 STOP 48 STOP 49 STOP 50 STOP 51 STOP 52 STOP 53 STOP 54 STOP 55 STOP 56 STOP 57 STOP 58 STOP 59 STOP 60 STOP 61 STOP 62 STOP 63 STOP 64 STOP 65 STOP 66 STOP 67 STOP 68 STOP 69 STOP 70 STOP 71 STOP 72 STOP 73 STOP 74 STOP 75 STOP 76 STOP 77 STOP 78 STOP 79 STOP 80 STOP 81 STOP 82 STOP 83 STOP 84 STOP 85 STOP 86 STOP 87 STOP 88 STOP 89 STOP 90 STOP 91 STOP 92 STOP 93 STOP 94 STOP 95 STOP 96 STOP 97 STOP 98 STOP 99 STOP 100 STOP

CONNECTIONS FOR 3 WIRE PHASE CONTROL DEVICE

WIRING DIAGRAM

3 PHASE
START
STOP
MOTOR
LINE ON 1 PH 4 WIRE L3 AND L2 ARE PHASE 1 L3 AND L4 ARE PHASE 2 CONNECT MOTOR LEADS AS FOLLOWS:
T1 TO T1 T2 TO T2 T3 TO T3 T4 TO T4
T4 SOLID

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Bulletin 709 Solenoid Starter showing over-load relays.

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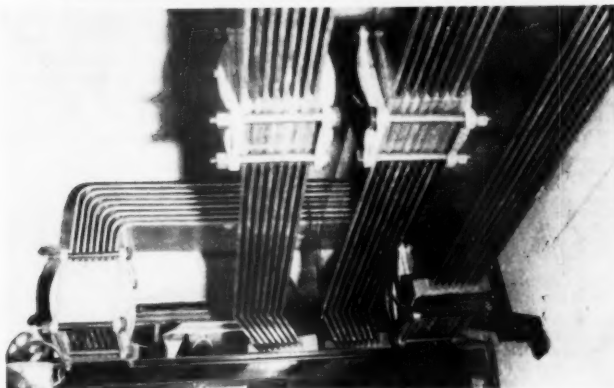
All line and load terminals are front connected—they are easy to get at.



There is plenty of space in the enclosures for power and control wires.

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY

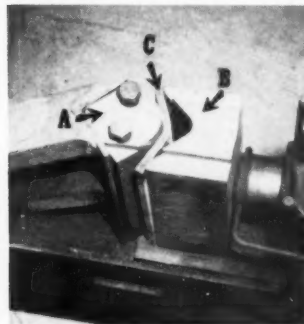
Practical Methods



OFFSETS LIKE THESE in bus bar circuits were made on a bender.



A MACHINE LIKE THIS consists of steel dies and hydraulic conduit bender mounted on special steel horse.



CLOSE-UP OF BENDER showing copper bar (C) being bent against ordinary die (A) as V-block (B) on plunger moves forward. Bus can be lifted from bender after operation is complete.

Conduit Bender Forms Heavy Bus Bar Offsets

TOOLS

Approximately three million pounds of copper bus bars were installed by the Howard P. Foley Company, electrical contractors, at the recently completed electrolytic refining plant of the Kennecott Copper Corp. near Salt Lake City, Utah. High amperage, low-voltage circuits to the various "pot" lines consisted of eight $\frac{1}{2}$ -in. by 10-in. copper busses in parallel per leg (positive and negative); were installed in open areas underneath the electrolytic tanks.

Hundreds of right-angle bends and other offsets were necessary to carry the bus circuits around acid lines, other pipes and building columns. To make these offsets on the 10-inch bus, Foley engineers mounted a conventional hydraulic conduit bender on a specially designed steel "horse" and equipped it with removable jigs and fixtures for the various degrees of offset.

Since it required about 4,500 pounds pressure to start a bend on the $\frac{1}{2}$ -in. by 10-in. bus bar, a heavy bender was used. The bender was bolted and braced to the top of the channel-iron horse. Mounted to the end of the hydraulic plunger was a movable, machined V-block (or fixture) high enough to accommodate the 10-inch bus bar and wide enough to make the 90-degree offset. Directly in front of the plunger block was bolted a machined steel die around which the copper bus bar was bent. The die was supported against the tremendous lateral thrust by a heavy channel and angle-iron bracket welded to the top of

the supporting horse.

The unit was designed specifically to speed up the bus bending operation. Straight lengths of 10-inch copper bus bar could easily be "dropped" between the dies and quickly lifted up after the offset was made. Hand operation of the bender assured close control of bending pressure—a necessity where accuracy was important to paralleling of offset bars.

50 Amp Trolley Bus Is Commercial Boon

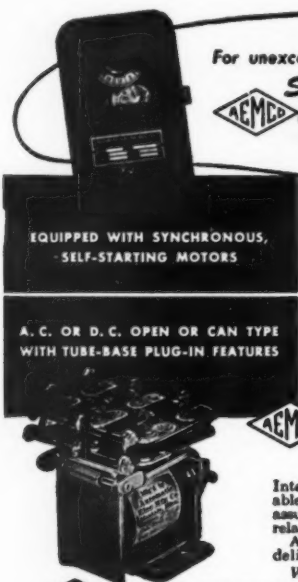
MANUFACTURING

Small power tools, lighting fixtures, appliances and business machines can be positioned at any desired point along runs of plug-in or trolley busways, according to R. Kolodney & Company of Hartford, Connecticut. As a result, equipment can be located in accordance with shifting needs, rewiring for each change is unnecessary, and extension cords can be shortened.

The Kolodney Company, manufacturers of women's clothing, finds that



FLEX-A-POWER BUSWAY, installed over cutting tables of dress manufacturer, makes it possible for cutters to be moved along table without necessity of shifting extension plug from socket to socket. Busway is also useful for positioning business machines, lighting fixtures and appliances as desired.



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Highest quality material and unexcelled craftsmanship combine to make Automatic Time Switches the preference of those who demand long life dependability backed by an unconditional guarantee.

Compact, carefully engineered Automatic Time Switches have new type, easily set trip levers. Trip levers and dial are visible thru window in attractively finished, tamper-proof case.

Stock Models: Single Circuit, Single Pole, 10 Amperes Capacity to Two Circuit, Four Pole, 45 Amperes Per Pole Capacity. Special models engineered to your requirements.



RELAYS

Automatic Electric Relays . . . Midget, Interlocking, Circuit Control, Latching, Adjustable . . . are built to exacting high standards to assure unexcelled dependability. Custom built relays designed to your specifications.

Accurately rated Automatic Electric Relays deliver "Diamond Quality" performance.

Write for complete specifications.



LOOK FOR THE DIAMOND SEAL FOR DIAMOND QUALITY

Automatic Electric MFG. CO.

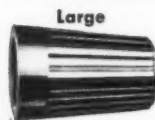
50 STATE STREET
MANKATO, MINNESOTA

AUSTIN "SCREW-ON" CONNECTORS

Licensed under United States
Letters Patent No. 1,933,555



are faster,
safer and
neater—



Large



Standard



Small



Midget

NO SOLDER, NO TAPE, NO ADDITIONAL TOOLS

The Austin Screw-on Connector is a molded phenolic plastic shell with a copper coated spring inserted *after* molding. Provides 25% lower electrical resistance and up to 3 times the tensile strength.

Just strip the wires, insert into connector, and twist. The spring expands and rolls a thread onto copper conductors. When you stop twisting, the spring tightens down and grips conductors firmly. Connector is skirted so insulated portion of wires is drawn up into connector for complete insulation.



STRIP WIRES



SCREW ON CONNECTOR



IT ROLLS THE THREAD ON

Write for Information and Prices

THE M. B. AUSTIN COMPANY
NORTHBROOK, ILLINOIS

cutters connected to their Trumbull LTG 50-amp 250-volt Flex-A-Power installation speed cutting operations and improve accuracy, for the absence of long extension cords and the associated tugging action on the cutting tool eliminates the possibility of cutting multiple layers of cloth on an angle. Cutting tools can be carried along the length of cutting tables, cords do not have to be shifted from socket to socket, operators have both hands free to handle the tools and cloth, and the tripping hazard of cords on the floor is removed.

Rotating Bins Stock Variety of Devices

STORAGE

Approximately 320 different types of wiring devices and conduit accessories are stocked in four rotating bins in the center of a stock room at the Clarence W. Silver Company in Salt Lake City, Utah. Each "Rotabin" is 35 inches in diameter; 66 inches high; has eight rotating, pan-type shelves with five major divisions. In most cases, each major division is partitioned into two or more pie-shaped "bins" as required. Normally, one Rotabin has at least 80 different items on its shelves. The four units occupy a floor space approximately 12 feet by three feet.

Such miscellaneous items as couplings, straps, bushings, connectors, receptacles, sockets, switch plates and similar devices are stocked on these shelves. Each bin is clearly labeled for quick identification of the items.



DEVICES can be quickly located as shelves are rotated. Unit offers quick visual inventory of material on hand. Note how bin dimensions can be varied by separators.

not one...but all three

...all three electrical tapes are
important to meet the specifications
of the electrical trade!

the "Dutch Brand" trio



DUTCH BRAND *Friction* Tape

DUTCH BRAND Friction Tape is one of the most widely used friction tapes on the market today. The electrical group finds it easy to use and accords it high preference. It is a quality tape that is long-lasting, it sticks tight, it tears straight, wraps neatly and does not ravel. Its tensile strength exceeds requirements, and the careful choice of materials and manufacturing process result in excellent aging qualities. The most important point . . . you can buy and use it with confidence.



DUTCH BRAND PLASTIX Electrical Tape

DUTCH BRAND PLASTIX is made with the tape "know-how" of more than forty years' experience. PLASTIX is superthin with high dielectric resistance . . . conforms readily to irregular surfaces, . . . stands up under severest conditions . . . resists water, oil, acids, alkalis and corrosive chemicals.

It is available in regular .007" thickness and heavy-duty .010" thickness. The .010" PLASTIX has all the general characteristics of regular PLASTIX except it is heavier for heavy-duty work such as winding heavy cables, heavy electrical harness and for use in tape winding machines.

DUTCH BRAND *Rubber* Insulating Tape

DUTCH BRAND Rubber Tape is well known to the trade for its top insulating quality. It has been one of the outstanding electrical tapes in the field for years. To use it is to appreciate this quality for it fuses instantly without heat, insulates perfectly, stretches readily and contains no corrosive chemicals. DUTCH BRAND Rubber Tape resists up to 18,000 volts through a single thickness. It is strong, durable and easy to use.

When used with DUTCH BRAND Friction Tape you have top insulating value. That's why you find it used on high-tension lines and other places where dependable insulation is an important factor. Be sure you get the genuine . . . specify DUTCH BRAND by trade name.



Available in practical sizes
and packaging for contractors
and industrial users.



VAN CLEEF BROS. INC.

Manufacturers . . . Rubber Products . . . Est. 1910
CHICAGO 19, U. S. A.



with
Standard
TRADE MARK

DRY TYPE TRANSFORMERS

1 — Increased efficiency of lighting and motors; 2 — Low-cost movability for relocation; 3 — Out-of-way installation of small transformers; 4 — Indoor installation of substation sizes; 5 — Less and easier maintenance; 6 — Saving of space and enclosure construction costs.

300 KVA dry type. Sizes from 50 VA to 1000 KVA. Special sizes built to specific requirements.

POWER, DISTRIBUTION, INSTRUMENT, STREET LIGHTING AND TESTING TRANSFORMERS — OIL, ASKAREL OR AIR-COOLED

THE STANDARD TRANSFORMER COMPANY
WARREN, OHIO • OFFICES IN PRINCIPAL CITIES



SYNTRON

ELECTRIC HAMMERS

Don't risk losing money on those jobs that require drilling, cutting, chipping or channelling thru concrete and masonry. These dynamic little "earners", delivering 3600 power-packed blows per minute, do the work ten times faster than by hand. They actually pay for themselves at the job-tried rate of \$4.00 every hour of use. And most important —Syntron Electric Hammers are built to "take it", on job after job, year after year. Four models—all small in size but plenty big in power.

ELECTRIC HAMMER DRILLS



3600 hard blows every minute plus automatic rotation of the drill bit provides for drilling hundreds of holes daily in concrete or masonry. Two sturdy, lightweight models.

Write for Literature



SYNTRON CO.

690 Lexington Ave.

Homer City, Pa.

Personnel at the Silver shop report these advantages: It takes only a second or two to locate the material wanted; the bins give a quick visual inventory of material on hand; the shelves can be sub-divided at will to provide smaller or larger bin space for a large number of items; the units provide a flexible storage system since they can be relocated with ease.

Other permanent shelves around the walls of the store room provide storage bins and racks for heavy conduit fittings, motor bearings, switches and controllers, and magnet wire.

Alarm System Aids Cable Maintenance

COMMUNICATIONS

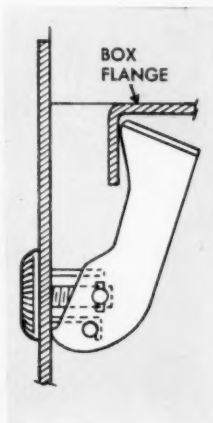
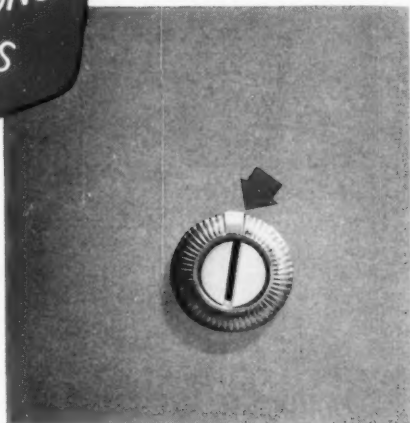
The Long Lines department of the American Telephone and Telegraph Company is now keeping tabs on lonely stretches along the 650-mile Dallas-El Paso coaxial cable with the aid of ingenious time-saving signalling equipment. Now maintenance men at the Dallas central station can detect cable faults at great distances and can effect emergency adjustments at trouble spots by dialing orders to this new device.

The system keeps watch over ten main repeater stations, it is capable of indicating 160 trouble conditions and can often forewarn of coming difficulties. It reports blown fuses, improper functioning of the power machinery for charging batteries, and cable failures. It also checks attendant hazards, such as dangerously low gasoline supply for emergency generators. Depending upon the seriousness of the trouble, different sets of lights are illuminated in the Dallas control station. The attendant can quickly determine the exact nature of the trouble by dialing an order to the distant unoccupied office. This dialing starts a special indicating circuit operating that scans every alarm lead and transmits all alarm conditions, registering the trouble by means of lights on an indicating receiving lamp panel. By placing a translucent indicator form over the panel and checking the relative position of each lighted lamp, the Dallas attendant can obtain a fast detailed picture of the type of trouble existing and the identification of the remote unattended station. Some trouble calls must be answered by a maintenance man visiting the station but many calls can be cleared up by dialing further orders to the new equipment.

Now being thoroughly tested by Bell Laboratories, this B-1 Alarm and Control System makes it possible for Long Lines maintenance men to perform more than 100 corrective operations in distant offices, without having to leave

YOU CAN BE **SURE**.. IF IT'S
Westinghouse

**FAST INSTALLATIONS
CUT JOB COSTS**



Speed panelboard trim installations ...with **INDICATING TRIM CLAMPS!**

Indicating, adjustable trim clamps? Just a long name for a little device that enables you to install Westinghouse Panelboards *fast!*

A dial-type indicator on the outside of the trim or cabinet front eliminates the need for "x-ray eyes", or working by "feel". The dial shows when the clamp is in the proper position for tightening. A small detail, perhaps, but one that effects a substantial cut in panelboard installation time... one that you can measure in terms of dollars saved! Moreover, it's just one of many Westinghouse features that contributes to greater ease in installation. Check these additional "time savers":

Phase Identification on 3-phase, 4-wire lighting panelboards speeds up wiring by eliminating the necessity for "ringing out."

Quick-fasten access plates to slash panelboard assembly time.

Taken separately, these are little things, of course. But collectively they make a big difference in final panelboard costs... a difference that will enable you to buy quality-constructed panelboards for every job. And you can be *sure* about quality if it's Westinghouse.

Descriptive Bulletin 30-930 contains complete details. For your copy, write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-40387

Westinghouse
PANELBOARDS





MINIMUM INVENTORY One- and two-circuit Load Centers are individually cartoned. Load Centers from 4 to 20 circuits entail no great inventory problem. Trumbull ships these units in the following manner: Enclosure, interior and two breakers are packed in a carton with sufficient space provided to include a front and additional breakers... Fronts are packaged in envelopes and stocked

separately... Breakers are also individually cartoned and stocked separately.

Because of this method of packaging it is possible to provide directly from a stock any Load Center from 4 to 20 circuits and still maintain a minimum basic inventory and provide for the greatest flexibility in conserving stock space.

NOW YOU NEED LESS STOCK

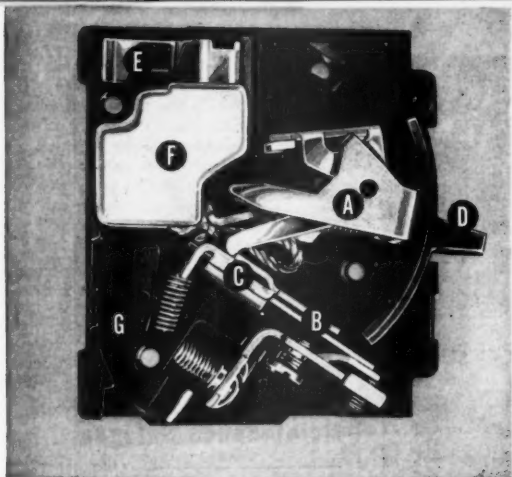
to fill more orders for load centers

We built the new TRUMBULLITE line of Load Centers with you in mind as well as the user.

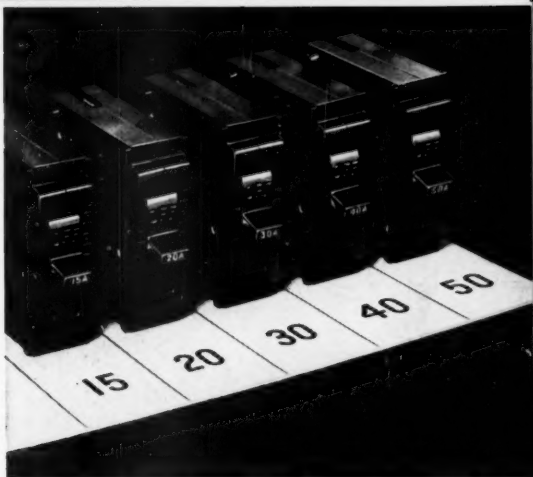
You'll not only benefit from handling the most modern line of Load Centers — with far and away more wanted features than any other make...

You'll also need to tie up *less money in inventory.*

With the TRUMBULLITE line of Load Centers, you can maintain at all times a *complete stock* for all circuit requirements at a dollar cost much less than ever before possible.



BREAKER SELLING POINTS Now you can offer your customers Load Centers with all the features of high-quality panelboards, such as quick-make, quick-break circuit breakers—at ordinary Load Center prices! They will immediately recognize the value in such TQL Breaker features as *quick-make, quick-break* (A); *double protection*—thermal (B) for excessive overload and magnetic (C) for short circuit; trip-indicating, trip-free handle (D); pressure type contacts (E); positive arc-quenching (F);



exhaust chamber (G); *Underwriters' Laboratories Inc. approved.*

Trumbull TQL Breakers are physically interchangeable. Regardless of the current rating, any TQL Breaker physically fits the TRUMBULLITE busbar and stab assembly. Ratings are clearly stamped on the handle. Rating: 15, 20, 30, 40, 50 amperes; 120 volt A-C, 120/240 volt A-C. Two-pole operation is made possible with a handle extension.

MORE VALUE THAN EVER BEFORE IN LOAD CENTER



EASY MOUNTING With box mounted on wall, the four captive springs permit easy mounting of interior (see right). They also allow "lining up" of fronts, regardless of uneven box installation. Note solid groundable neutral.

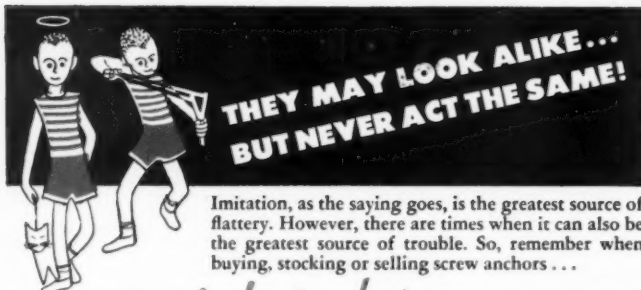


RUGGED BUSBAR AND STABS No porcelain insulators to break. Busbars and stabs are silver-plated copper for positive conductivity. (Note anchor on back plate which grasps recess of breaker.)

Write for new bulletin TEB-12 on TRUMBULLITE Load Centers

TRUMBULL ELECTRIC

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY
PLAINVILLE, CONN.



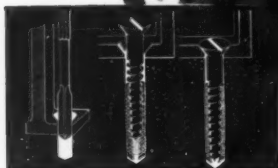
Substitutes CAN PROVE DANGEROUS!

The word "Rawlplug" used in connection with Jute Fibre Screw Anchors is exclusively the property of The Rawlplug Company, Inc. For forty years it has been secured to them by common law and by trademark registry. It is the corporate and trade name of the company and specific product of their manufacture.

BE SECURE BY BEING SURE

Look for the Trade Name

RAWLPLUGS
on the Blue Box



When you use Rawlplugs you are using the original and genuine... the only screw anchor with the features that make them worthy of imitation... RAWLPLUG!

RAWLPLUGS because of their chemically treated braided jute fibre construction... Hold Better... Last Longer... Weigh Less and Hold More! They... Eliminate extra troublesome spotting and layout work. Rawlplugs are the only universal anchors which can be used in any material.

"IF YOU DON'T USE **RAWLPLUGS**... THERE'S A SCREW LOOSE SOMEWHERE!"

For further information write Dept. E

12-L-1

THE RAWLPLUG COMPANY, INC.
271 CHURCH STREET • NEW YORK 13, N. Y.



THERE ARE RAWL PLUGS, EXPANSION BOLTS, SCREW ANCHORS AND MASONRY DRILLS FOR EVERY NEED
SOLD THROUGH ALL LEADING HARDWARE, ELECTRICAL AND MILL SUPPLY HOUSES



the Dallas control panel. For example; maintenance men can start an emergency generator in the distant offices, and can remotely locate the exact position of a transmission failure along the coaxial cable route. It is also possible to switch from one coaxial tube to an alternate one by remote control in case a service interruption is threatened. It is anticipated that similar systems will soon be installed along other coaxial routes in the sparsely settled areas of the southwest where conditions warrant.

Simple Safety Tag Is Maintenance Safeguard

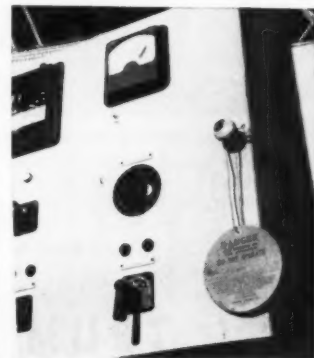
MAINTENANCE

The safety records existing in G.E.'s vast Schenectady, New York, plant were not established by luck. Rather, they prove the wisdom of establishing and rigidly enforcing precautionary rules based on the company's many years of experience with both electrical and mechanical construction and maintenance.

One of numerous practical safety practices is the use of a tag which is fastened to controls or switchgear whenever work is being performed on the connected circuits.

These tags, signed and dated by the person in charge of the shutdown, are plainly visible. They indicate that power is not to be placed on the connected circuits. Only responsible persons have the authority to place or remove the tags.

By this simple precaution, men working on a dead circuit are not endangered by having power suddenly turned on at a remote point in the plant.



SAFETY TAG, dated and signed by person in authority, is plainly displayed on switchgear when a circuit is taken out of operation for maintenance or other purposes.

FOR A PLAYING FIELD...

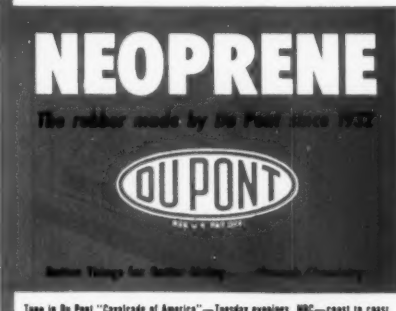
...OR AN AIRFIELD



Neoprene-jacketed cable assures long-lasting, dependable service

For athletic field or airport lighting . . . installed overhead or underground . . . neoprene-jacketed cable is *right* for the job. Installations that have been up for over eleven years prove continuous exposure to glaring sun has little effect on neoprene. Soil acids won't cause it to rot underground. Galvanic action, destroyer of metal sheaths, won't harm neoprene. Even on oil and gasoline soaked runways, neoprene won't become soft and sticky. It provides lasting protection for the insulation under toughest conditions.

So ask your supplier about neoprene-jacketed cable. Leading manufacturers make it in single or multiple conductor types, in voltage rating to fit your requirements. You'll find this cable costs less to maintain and requires fewer replacements . . . whether the service is rural, urban or industrial. For some ideas about new neoprene applications that may help you, send for "The Neoprene Notebook." No charge, of course. Write: E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division T-3, Wilmington 98, Delaware.



The 60-second gold mine!

60 SECONDS MAKE A MINUTE . . . minutes run into hours and into *money* before you know it! And that's why Gedney Fittings are the best buy obtainable today. Gedney Fittings are machined with absolute accuracy. They'll save you the minutes that can add up to hundreds of dollars of a workman's time—each year!



GEDNEY FITTINGS FIT!

- ★ Accurate castings of malleable iron . . . no breakage.
- ★ Threads cut true . . . perfect conduit alignment.
- ★ Designed to fit . . . vibration cannot work it loose.



GEDNEY
ELECTRIC COMPANY



RKO BLDG. • RADIO CITY • NEW YORK 20
Foundry, Factory and Shipping Point: Terryville, Conn.

Quick Estimates 2.

By Wallace M. Adache*

Adache & Case, Engineers
Cleveland, Ohio

Data for preliminary cost estimates on underground lines, manholes and cables. Figures are for larger type projects and based upon current prices. For further explanation see text page 48, Electrical Construction and Maintenance, January 1951.

Trench-Lay 600 V. Cable & Bare Copper Ground Wire Installed with Connectors and Splices, Trenching and Back Fill Not included. + 50%

Size AWG	2/c Parkway Non-Met.	3/c Parkway Non-Met.	2/c Parkway Armored	3/c Parkway Armored	Bare Copper Gr. Wire
14	.18	.30	.30	.45	
12	.21	.35	.35	.55	
10	.24	.40	.40	.70	
8	.33	.55	.55	.90	.30
6	.42	.70	.70	1.15	.40
4	.53	.90	1.00	1.45	.45
2	.75	1.20	1.30	1.70	.60
0		1.60		2.50	.90
2/0		1.90		3.00	1.15
4/0					1.50

Ground Rod Installed

Size	5/8"	3/4"	1"
Per Foot	\$1.90	\$2.30	\$2.60

RW or Polychloroprene wire, RL or Lead Covered Cable, Installed in Present Underground Duct or Conduit

AWG MCM	600 V. RW-1/c*	5000 V. RW-1/c*	600 V. RL-1/c*	3000 V. RL-1/c*	5000 V. RL-1/c*
14	.09				
12	.11		.25		
10	.12		.30		
8	.15	.30	.35		
6	.20	.40	.45	.60	.90
4	.30	.55	.60	.75	1.05
2	.40	.70	.75	1.00	1.30
0	.55	.85	1.00	1.15	1.50
2/0	.70	1.00	1.15	1.30	1.65
3/0	.85	1.20	1.30	1.45	1.80
4/0	1.00	1.35	1.50	1.70	2.10
250	1.15	1.50	1.65	1.95	2.40
350	1.50	1.80	2.10	2.40	2.70
500	1.95	2.30	2.70	3.00	3.50
750	2.90	3.40	3.90		
1000	3.60				

* For 3/c Cable Multiply Above Single Conductor by 3.

Manhole, reinforced concrete, installed complete with MH cover, ladder, pulling eye, cable racks, water-proofing, etc.

Inside Measurement-width-length-height

Wall	Size	Total Cu. Ft.	Total	Cu. Ft.
6"	4' x 6' x 4'	100	\$405.00	\$4.05
8"	5' x 7' x 5'-8"	200	685.00	3.42
8"	6' x 9' x 5'-8"	300	875.00	2.90
8"	8' x 8' x 6'	400	1,060.00	2.65

Special concrete manholes installed (See drawings Page 75)

Type	Wall	Height	Total
Standard Straight.....	6"	5'-8"	\$875.00
Standard 90° angle.....	8" & 12"	5'-8"	1,060.00
Three Way.....	8" & 12"	6'-0"	1,125.00
Power & Signal Straight.....	8"	5'-8"	1,500.00
Power & Signal 90° angle.....	8" & 12"	5'-8"	1,620.00

4" Fibre duct installed, encased in concrete

Number of Ducts in Run	Each Duct Per Foot	Number of Ducts in Run	Each Duct Per Foot
1	\$3.75	12	\$2.19
2	3.13	16	2.06
3	2.80	20	2.00
4	2.80	25	1.94
6	2.62	30	1.87
8	2.38	More than 30	1.87

Trenching and backfill for trench-lay cables, and ground wires. Cables not included

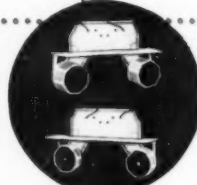
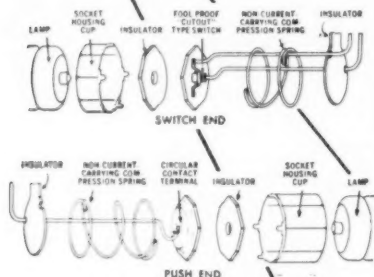
Depth	12"	18"	24"
L'Ft by Hand.....	.44	.75	1.25
L'Ft by Machine.....	.31	.44	.62

* Copyright by author and used by permission. Articles are selected abstracts from the manuscript of a forthcoming book on electrical construction design standards.

BENJAMIN "MAGNA-FLO" SYSTEMS



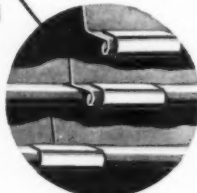
"SPRINGLOX" Construction Features



"SPRINGLOX" LAMPHOLDERS,

exclusive with Benjamin, are of patented construction which greatly simplifies and speeds up lamp insertion and removal. All-metal construction; lamp-pin contacts will not twist or distort from repeated relamping; nothing to get out of order. Entire lampholder assembly is rigidly locked into place on the reflector so that it cannot be shaken out of line.

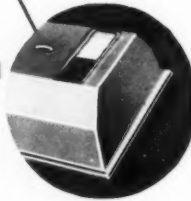
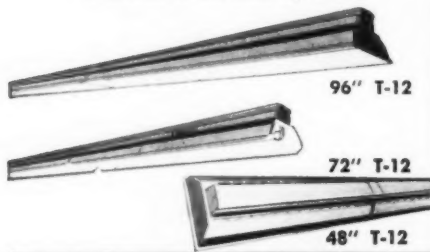
INDIVIDUAL Units



TWO-SECTION REFLECTORS

are easy to handle. Sections overlap $\frac{3}{4}$ " and are held rigidly in line by positive alignment clip.

CONTINUOUS Line Systems



"MAGNA-FLO" REFLECTORS

are finished in Benjamin "Life-Time" Porcelain Enamel. This flint-hard, non-porous reflecting surface assures longer life with sustained high lighting efficiency, due to the fact that it is easily restored to efficiency by simple soap-and-water cleaning.

Most modern solution to DEFENSE PRODUCTION LIGHTING PROBLEMS

Modern, streamlined lighting of factories and shops may now be obtained with this new Benjamin Line, designed for use with the new, long-life, 96-inch, 72-inch and 48-inch Slimline Fluorescent Lamps, which have a greater light output than any other fluorescent lamp.

"Magna-Flo" Systems are available in either individual units or, where higher lighting levels are desired, in continuous-line type of construction. Closed or RLM open-end reflectors are available. Individual "Magna-Flo" units are listed as complete items, while the continuous line "Magna-Flo" Systems are built up from standard channel sections, couplings, end caps and closed or open-end porcelain-enameled steel reflectors.

The outstanding feature of "Magna-Flo" lighting equipment is the new, single-pin "Springlox" Lampholder—an exclusive Benjamin development.

"Springlox" Lampholders lower maintenance costs by cutting down on relamping time; by dependable operation and rugged construction and mounting.

"Springlox" Lampholders are designed for safety, too. Lamps of even minimum and maximum tolerance are locked into place; cannot vibrate loose.

The switch-end (see drawing above at left) of "Springlox" has a fast-acting, cutout switch for the primary circuit that protects against shock when inserting or removing lamps.

FOR FREE CATALOG BULLETIN AD-5705, WRITE:

BENJAMIN ELECTRIC MFG. CO.,
Dept. M, Des Plaines, Illinois
Benjamin Lighting Equipment is sold exclusively through Electrical Distributors.



ECM:LS

Industrial Electrification

Flexible Power

Wound-rotor motors provide speed control, low starting current and high starting torque.

By R. F. Horrell
Electrical Design Engineer, Induction Motors
Electric Machinery Mfg. Company,
Minneapolis, Minn.

AN induction motor is a device for converting electrical energy into mechanical energy. It is essentially a torque machine with the rating usually given in horsepower. The torque required at a given speed depends upon the application. The horsepower rating is the product of the rated torque and the rated speed divided by the constant 5250.

The application of induction motors involves three factors of fundamental importance. These are:

1. The stator electrical speed minus the rotor electrical speed equals the rotor mechanical speed.
2. The rotor mechanical torque is equal to the electrical torque of the magnetic field set up by the stator.
3. Neglecting losses, the power output of the motor is equal to the power input regardless of the number of power inputs and outputs.

The third factor may be illustrated by a motor whose input consists of shaft output, rotor slip loss, and stator loss. Losses, as heat, are considered as outputs. After the stator loss is subtracted from the input, the remaining input is divided between slip loss and shaft output. For a given torque, the input is substantially constant regardless of the division of outputs.

For a motor operating on Curve 1, Figure 2, the shaft output plus the slip loss *oa* plus the stator loss equals the input. For operation on Curve 2, the shaft output plus the slip loss *ob* plus the stator losses equal the input. The efficiency of the motor, either squirrel-cage or wound-rotor, will be the same when operating on the same characteristic curve. However, the slip losses are dissipated outside the motor by the control resistances in the case of the wound-rotor motor, consequently the wound-rotor motor is capable of continuous operation at reduced speed (high slip). For such operation, the squirrel-cage motor must be physically larger than the wound-rotor motor.

It is easy to estimate the approximate efficiency of the induction motor for a given torque at reduced speed. If the slip S_1 and the efficiency e at the desired torque with shorted slip-rings is known, then the efficiency will be approximately $1-S_2$, where S_2 is

$$1-S_1$$

the slip at reduced speed.

A given torque may be obtained at

any speed with the wound-rotor motor. With pure resistance in the secondary circuit, the current and power input will be constant for any speed at which the given torque is obtained. Actually, there is reactance as well as resistance in the rotor control circuit so that the current for a given torque will increase as zero speed is approached. The current for 100% torque at zero speed may be high as 130% full load current.

A previous series of articles, ("Induction Motors in Industry", E. C. & M., May, June, July, 1950), discussed in some detail the squirrel-cage induction motor with which everyone is somewhat familiar. The squirrel-cage rotor conductors are in bar form and are short-circuited at each end by end-rings. The conductors may or may not be insulated from the rotor iron. The endrings are seldom, if ever, insulated. This construction necessarily fixes the rotor resistance at a given value. Once the rotor is manufactured, this resistance cannot be easily changed.

The squirrel-cage induction motor is capable of fulfilling a large percentage of the torque applications. Its simplicity, low cost, ruggedness and ease of maintenance has added to its popularity. However, the lack of speed control, the inability to obtain high starting torques with low inrush currents, and the difficulty of dissipating large slip losses make it desirable to use a wound-rotor induction motor where these characteristics are required.

The wound-rotor induction motor illustrated in Figure 1 operates upon the same principle as the squirrel-cage motor, but the secondary or rotor construction is different. The secondary is an insulated, phase-wound unit. The conductors make up coils which

are similar in many respects to the stator coils. The coils form the insulated winding which has the same number of poles and phase groups as the stator winding. The rotor winding connections terminate at slip-rings which connect through carbon brushes with the secondary control. This makes it possible to vary the secondary resistance—the all-important advantage of the wound-rotor motor.

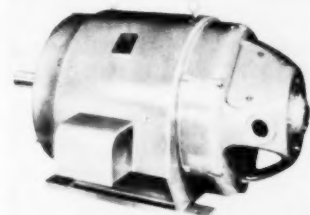


FIG. 1—Variable speed for output control can be secured by a heavy-duty wound-rotor induction motor such as this 200-hp 1750-rpm unit recommended for driving a centrifugal refrigeration compressor.

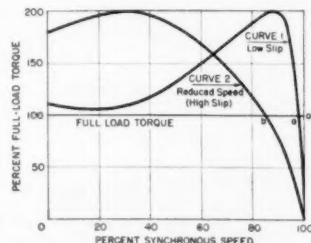
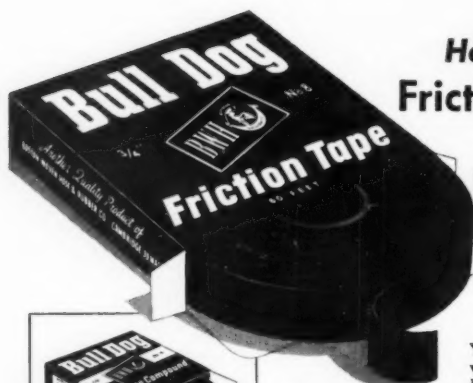


FIG. 2—Torque curves illustrate slip loss. After the stator loss is subtracted from the input, the remaining input is divided between slip loss and shaft output.



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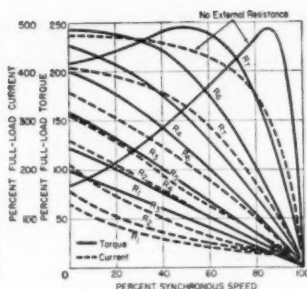


FIG. 3—Torques and current can be varied. By controlling the resistance in the secondary circuit, the maximum torque can be obtained at various speeds, with typical torque and current curves like the above.

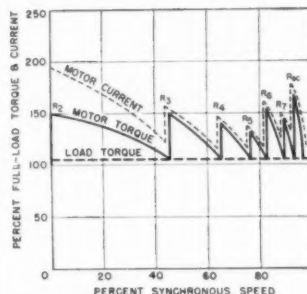


FIG. 4—Starting a constant-torque load. High accelerating torque for high inertia load is maintained by secondary resistance control.

Detailed application of the foregoing factors is beyond the scope of this article. They are applied in general by the wound-rotor motor as:

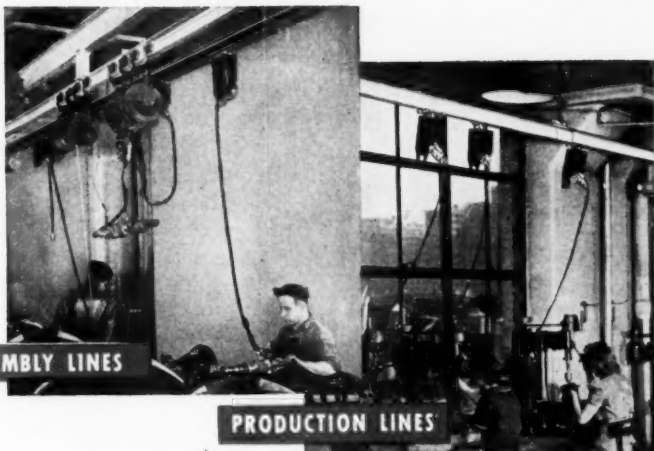
1. A wound-rotor motor and secondary control.
2. A frequency changer or a variable-frequency source of supply to run adjustable speed ac drives.
3. A means whereby the secondary power may be fed into a constant frequency bus.

Only the wound-rotor motor and secondary control will be discussed here as they cover the majority of wound-rotor motor applications. Numerous steps of resistance are inserted into the secondary circuit by the secondary control to obtain one or more of the following:

1. Low starting current and high torque.
2. Minimum current during acceleration.
3. Variable output of a driven machine by varying the speed for a given torque.

All of the secondary control resist-

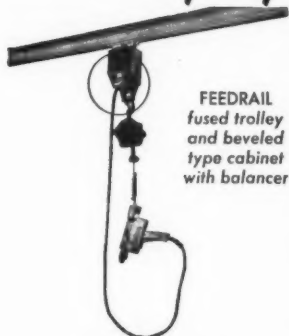
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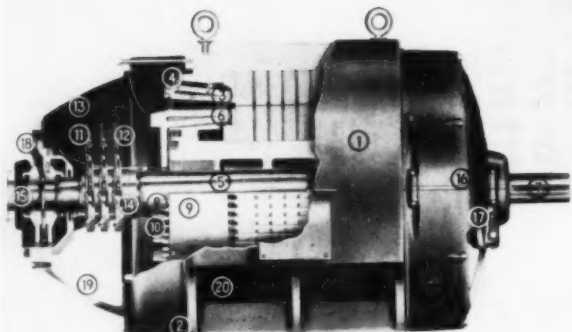


FIG. 5—An inside look into a large heavy-duty wound-rotor induction motor reveals (1) drip protection for shedding liquids and dirt, (2) steel frame for protection and rigidity, (3) form-wound stator coils, (4) blocked and lashed coil-ends, (5) large-diameter shaft, (6) pre-formed and pre-insulated rotor coils, (7) precision-balanced rotor, (8) silver-brazed coil connections, (9) stainless steel banding of coil ends, (10) copper fin blowers brazed to coil ends, (11) ratchet tension wheel to provide adjustment of brush pressure, (12) connector screws for brush replacement, (13) removable plates in upper half of bearing bracket for brush accessibility, (14) collector rings, (15) polished journals, babbitt lined, (16) split-type bearings, (17) oil gauge, (18) oil cap with large opening for inspection of oil ring, (19) low-velocity air intake and (20) air discharge at the feet, directed away from the motor.



FIG. 6—Brush pressure adjustment is provided by a "Klik-it" ratchet tension wheel, the side view of which is included as item 11 in Fig. 5. This tension wheel gives step-by-step increase or decrease in pressure on the individual brushes.

ance is placed into the secondary circuit at start. Approximately full load torque is obtained at zero speed with approximately 130% full load current inrush. Additional steps of resistance are short circuited as the motor comes up to speed in line with the requirements of the application.

The effect of the secondary resistance on the current and torques is shown in Figure 3. Each step of resistance fixes the current and torque to one particular curve. The maximum torque will occur at a lower speed as the resistance is increased but the value of the maximum torque remains

constant. With the proper secondary resistance it is possible to obtain the maximum torque as starting torque.

To control the speed at which a given torque is required, one merely varies the secondary resistance. It must be remembered that such operation is not an exact means of speed control if the load conditions vary.

The wound-rotor motor with secondary control is applied to:

1. Applications requiring high starting torque and low current, such as compressors and plunger pumps which start loaded.

2. Applications having high inertia requiring long acceleration periods. Here the high slip losses are dissipated outside of the motor. Figure 4 illustrates how this type of load can be brought up to speed with a minimum of current.

3. Applications requiring continuous operation at reduced speed such as centrifugal pumps, blowers, fans, etc. A speed reduction of 50% is possible for continuous operation. Figure 3 illustrates how full load torque can be obtained at reduced speed. It is not usually feasible economically either to operate at less than 50% speed at full load torque, or to attempt much speed reduction at light loads.

4. Applications where frequent starting, stopping, reversing and speed control are required, such as cranes, hoists, elevators, bending rolls, etc.

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In the News

New MSCI Committee

Formation of a new Liaison Committee of the Mechanical Specialty Contracting Industries has been announced by the national associations of the electrical, heating, piping, air conditioning and plumbing contracting industries.

The stated purpose of this new MSCI Liaison Committee is for the furtherance of the national defense program; to cooperate with the armed services and other branches of the government, the building construction industry and the Congress in all phases of the national defense effort. It represents the common interests of approximately 35,000 mechanical specialties contractors whose work involves approximately 50 percent of the dollar value of modern buildings. Their responsibility involves the management of the highest and most critically skilled mechanics in the building construction field.

In announcing the formation of the joint group, the new Liaison Committee issued the following statement:

"The Mechanical Specialty Contracting Industries have united in offering their full resources and services in furthering the National Defense Program. Theirs is the responsibility for the proper coordination and installation of electrical, heating, piping, air conditioning and plumbing systems in building projects. Together, these thousands of small business enterprises contribute a substantial part of modern building, whether it be used for normal civilian pursuits or for the defense of America.

"Maximum production with rigorous economy in manpower, material and capital is imperative if our country is to meet today's challenges successfully. Mechanical Specialty Contracting Industries eagerly accept their share of the responsibility of helping to meet these imperative requirements and for that purpose have formed a Liaison Committee of the Mechanical Specialty Contracting Industries for the Furtherance of the National Defense Program.

"On their own initiative, these industries during and since World War II expanded their capacity to produce by three or four times. Their technical and supervisory staffs have broad experience. They employ more skilled craftsmen in their organizations. They have through experience and the use of new tools and equipment increased productivity. They have more



OFFICERS of The Electrical Maintenance Engineers Association of Southern California (Los Angeles) are: (L to R) executive committee member Henry R. Bente, Ralph E. Phillips Co.; president—Harold S. Davis, General Electric Co.; 1st vice-president—Frank J. Rohring, Southern California Edison Co.; executive committee member E. M. Croft, Cole Instrument Co.; executive committee member Bob Paden, Los Angeles Board of Education; and secretary-treasurer—Richard Rogers, Ace Day and Night Electric Company.

efficient management and scientific techniques.

"All of these advancements result from the desire of Mechanical Specialty Contractors to better serve their customers and to increase public demand for the goods and services they offer.

"From their experience in two World Wars the Mechanical Specialty Contractors offer their full services and expanded facilities to further national defense, and in the public interest suggest:

"I. That full use be made of existing mechanical specialty contractor organizations having tools, equipment, technical and supervisory staffs who are now prepared to do the job, instead of allowing them to stand idle while inexperienced and inefficient high-cost organizations are developed.

"II. That job management functions and experience-tested industry practices be given full play and encouraged rather than suppressed or supplanted by arbitrary and unrealistic policies or procedures.

"III. That mechanical specialty contractors be assigned complete responsibility for the procurement of all equipment, material and labor required to accomplish their part of the project.

"IV. That normal contracting procedures be followed to permit the awarding of the mechanical specialty work to established organizations of experience and proven capabilities.

"These suggestions are respectfully brought to the attention of the Depart-

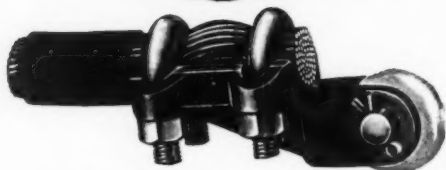
ment of Defense, the other agencies of the federal government concerned with construction, and to the public and its representatives in the Congress for the purpose of achieving a fuller utilization of our industries' dynamic forces in defense of our country."

Members of the Liaison Committee include the top executives of the three mechanical specialty contracting industries, and are as follows: V. J. Killian, Winnetka, Ill., president, and W. F. Clucas, Washington, D. C., executive secretary—National Association of Master Plumbers; Edw. Vanderlinde, Rochester, N. Y., president, and Paul M. Geary, Washington, D. C., executive vice president—National Electrical Contractors Association, Inc.; and Wray M. Scott, Omaha, Nebr., president, and Joseph C. Fitts, New York, N. Y., secretary—Heating, Piping and Air Conditioning Contractors National Association. George B. Roscoe, director of Public Relations for the National Electrical Contractors Association, is secretary.

NISA Holds Copper Conference

At their annual winter meeting, the Northeastern Chapters of the National Industrial Service Association held a timely "Copper Conference". Meeting at the Hotel Mayflower in Washington, D. C., on January 20, 1951, this

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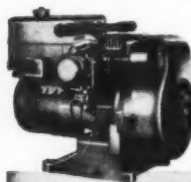
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ESSEX (N. J.) ELECTRICAL LEAGUE Maintenance Division will be led during 1951 by newly-elected president George Statz (right), Maintenance Supervisor for A. L. Davis, Inc., Newark electrical contractors. Presenting the gavel of authority is retiring president Berny Heyrich, Maintenance Supervisor for National Electrical Company of Passaic, while Andy Jacobus (center) a past president and the installing officer, Lighting Electric Service Co., Newark, looks on. Ceremony took place at the Division's December meeting.

conference was attended by approximately 175 members, and by various government officials, representing the Department of Agriculture, the office of the Surgeon General, U. S. Army, and the National Production Authority of the Department of Commerce. Among the members attending were many of the national officers, including H. E. Grant, President, Nashville, Tenn., Fred B. Wiperman, Executive Secretary, St. Louis, Mo., and R. E. Ward, Past-President (1950), Raleigh, N. C.

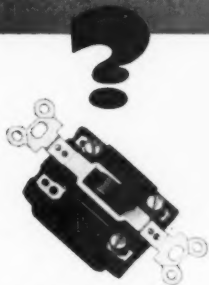
The day-long one day conference was divided into two business sessions—one morning session and an afternoon session—and an entertainment session, including a buffet dinner, in the evening.

The morning session was devoted to NISA business, shop practices and usual trade problems—excluding copper problems and shortages. Richard Harris of the Washington, (D. C.) Chapter was conference chairman. Invocation by R. E. Ward, Past-President, was followed by a short address of welcome by L. E. Hopkins, President of the Washington (D. C.) Chapter.

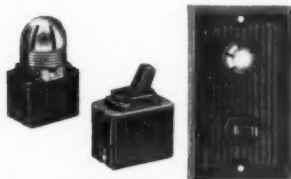
There were six speakers on the morning business session program, five of whom were NISA members, and the sixth from the Department of Labor.

First speaker was Sam Heller, of Consolidated Electric Motor Repair Co., New York City, who discussed "Shop Equipment", especially equipment for testing at variable voltages in the shop. He described his use of a 2 kva. "variac" for single phase testing. Another unit described, includ-

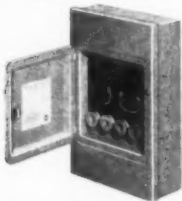
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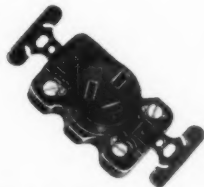
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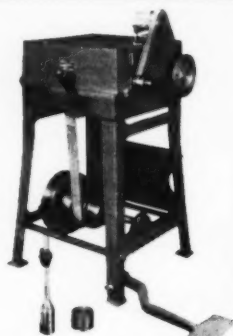
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AS DISTRICT MANAGER of the H. P. Foley Company's office in Salt Lake City, Utah, Glenn F. Staker is responsible for the western construction activities of this electrical contracting firm. A recent project: the installation of some three million pounds of copper bus at the Kennecott Copper Corp. refinery near Salt Lake City.

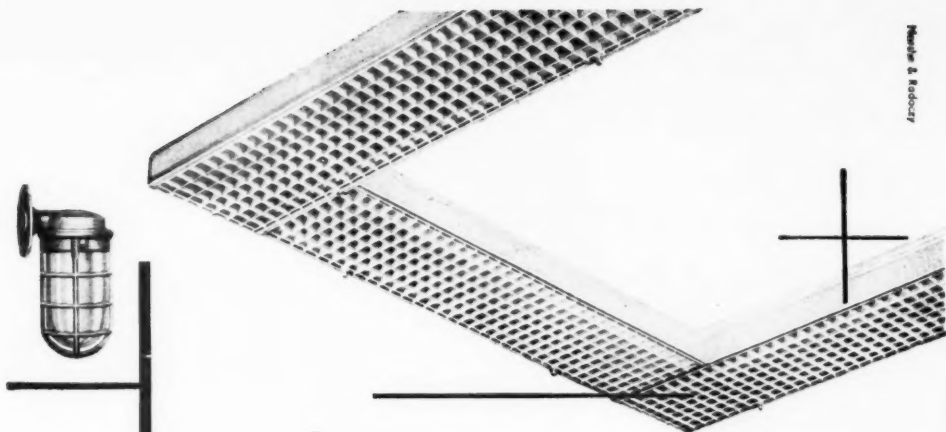
ing test practices, was a variable frequency M-G set providing frequencies up to 500 cycles.

Roland Stolzenbach of Roland Electric Co., Baltimore, Md., presented a discussion of the problem faced by all small businesses, namely, the grasp for power by the Federal bureaucracy over their means of livelihood. Title for his talk was "Are We Men or Mice?", paraphrased as "Do We Run or Do We Fight?". He outlined in considerable detail how amendments to the Fair Labor Standards Act, sponsored by big business, big unions, and politicians (both big and little), now compel little business to struggle for its existence—when they should be exempt from the act by virtue of the fact they are small business, do not engage in any appreciable interstate business, and are engaged primarily in local retail and service activities.

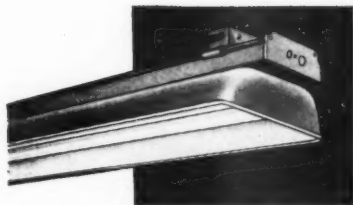
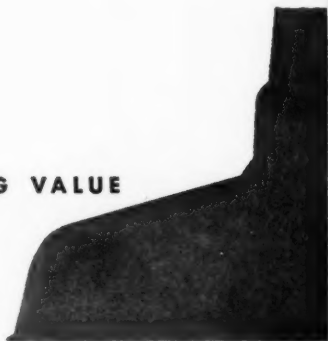
Bill Weirich of Lenni Products Co., Lenni, Pa., discussed "Insulation—Past, Present and Future". He dealt with paper treated with shellac, vulcanized fiber, fish paper, varnished cambric glued to paper, vinyl films, etc., and discussed the specific properties and qualities of each.

Mr. Wagner of Howard Davies Electric Service, Philadelphia, read a paper on "Electrical Testing" for Howard Davies, who was unable to attend. This paper stressed practices for conserving copper wire.

Final speaker for the morning session was Edward E. Goshen, Deputy Director, Bureau of Apprenticeship, U. S. Department of Labor, who spoke on the subject of "Apprenticeship". He outlined how the De-



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It is built on an 8-Point QUALITY standard, with rigid "Truss" construction, certified components, Bonderite-treated steel, and long-life finishes.

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Miller lighting equipment has engineering features which make for easy installation and maintenance, which explain its LOW OVERALL COST.

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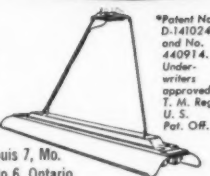
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TOP MEN at Wazee Electric Company, Denver, Colorado, are: (L to R) E. C. Armstrong, president, who handles all construction work; and R. L. Knoggs who is manager of motor sales and service.

partment of Labor assists in the establishment of an apprentice training program, how such programs work, and what has been done in this field in the past.

The afternoon session—the "Copper Conference"—was chairmanned by Richard Harris of the Washington (D.C.) Chapter. It opened with a talk by Ed Grant, NISA President, on the subject "How Can We Keep 'Em Running?". He first discussed what NISA is doing nationally, and suggested NISA members avail themselves of the revised "Three Phase Data Book". He set the theme for the session by telling the group what NISA has done about the copper situation, which was the appointment of a Task Committee, subsequently enlarged and given the name of "Defense Coordination Committee". Members of this committee were announced as follows: F. W. Willey, Wm. J. Wheeler, W. W. Hanks, R. E. Ward and Wm. S. Giles.

Chairman Harris next introduced Col. Stuart G. Smith, Chief, Supply Division, Office of the Surgeon General, who spoke briefly on the needs of the Army for motors and motor repair services—for hospitals and medical care in the Army.

Next speaker was L. B. Taylor, Division of Materials & Facilities, U. S. Dept. of Agriculture, who told of the urgent necessity for keeping the motors and electrified farm machinery in good repair, especially in view of the increasing shortage of manpower and labor on the farms of America.

The meeting was next opened for a round table discussion of the copper situation, especially as it related to



TESTING TIPS



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Here's an easy way to save time in determining the sequence of polyphase circuits. Let General Electric's handy phase-sequence indicator do it for you. For example, this compact little instrument shows you the proper connections for meters, instruments, and relays, as well as those for paralleling generators, transformer banks and power buses. You can quickly predetermine the direction of rotation of polyphase motors.

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Bad voltage can do strange things to plant equipment. For instance, if voltage is 10% low, lamps produce only 70% rated light. If voltage is 10% high, lamps will last only 29% of rated life. Generally, what is true of lighting applies to motors, heaters, and other electrical production tools. Usually the cause of the trouble is overloaded or underloaded distribution circuits, and you can correct many such difficulties by balancing the system. Of course, the first step is to accurately determine circuit voltage conditions.

You can get accurate records over an extended period of time with General Electric's type CF inkless recorder. It's designed for dependability and maximum convenience—runs as long as 30 days without attention, and can be used outdoors. You put it on the line; it comes up with a record on paper of circuit voltage conditions—just the information you need to appraise your distribution system. Available in a variety of voltage ranges, the CF inkless recorder has an accuracy of $\pm 1\frac{1}{2}$ per cent of full scale value. More details in GEC-215.



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Many electric furnaces have a habit of changing resistance with age. The longer they operate, the more power they require for the same amount of heat. Thus, it's good practice to make periodic checks of your furnaces, especially those connected in parallel. Knowing how much each one costs to operate allows you to replace heating elements as soon as they've outlived their usefulness.

With General Electric's type AK-2 hook-on wattmeter, this testing job is easy, and there's no interruption of service. You just clip the two potential leads across the line, hook the AK-2 around one conductor, and take your reading in watts. The AK-2 measures single-phase

and polyphase circuits with an accuracy of $\pm 5\%$ of full-scale value. Weighs only 4 pounds. For more details, check bulletin GEC-591.

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☐ phase-sequence indicator (GEC-374)
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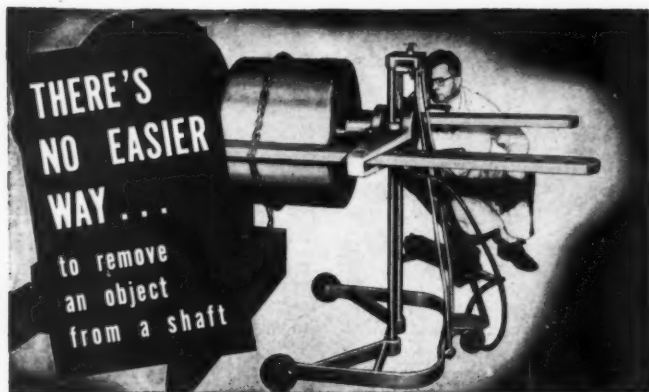
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magnet wire. Various members present were called on by Chairman Harris, and asked to relate their problems with respect to magnet wire.

Representatives of the National Production Authority present, who took part in the discussion of the current copper situation and shortage, were: C. B. Griffith, R. H. St. John, and Howard E. Way, all of the Machinery Section of the Machinery Division, NPA, which has jurisdiction of the controls and regulations of NPA affecting the electric motor repair industry. Also invited, but unable to attend this forum, was F. H. Hayes, Director of the Copper Division, NPA.

The seriousness of the copper shortage, and specifically of magnet wire in the various sizes, shapes, and types of insulation, as used by the electric motor repair shop industry, was made apparent by the many case histories reported by repair shop executives from all parts of the country. A particularly critical shortage exists in glass insulated wire, it was made evident. It was finally asked that members present report their most urgent problems direct to the Defense Coordination Committee, whose members were present at this Conference. The DCC was asked to assemble these data and to prepare a report for submission to the NPA officials before the Committee left Washington.

The Conference expressed a vote of thanks to the Washington (D. C.) Chapter, Conference host, and specifically to L. E. Hopkins, President, Richard and Lee Harris, for the excellent program and entertainment provided.



GRADUAL SHIFT from small motor to large motor work has brought Ed Neeley (left), owner; and Lamar Kay, office manager, of the Electric Motor & Supply Company, Salt Lake City, Utah, into the mining and industrial repair field.

No Other Alarm System Has ALL The Advantages Of

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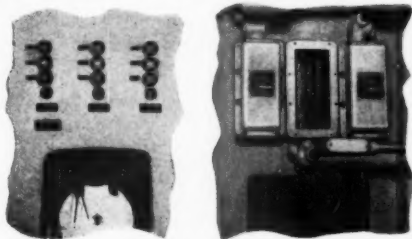
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9. Saves space, engineering costs, installation and maintenance over other alarm systems.
10. Acknowledgement-test switch permits periodic testing of each Unilarm circuit.

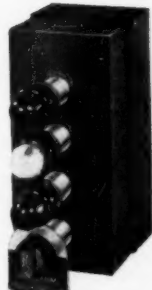
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D1

Special Explosion-Proof Unilarm Panel showing stock units, group mounted. Panel is factory wired, sealed and tested.



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- EASY TO REMOVE MECHANISM—just press spring.
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Charles L. Eidlitz

Charles L. Eidlitz, an Edison pioneer, who became one of the leading electrical contractors and manufacturers in New York City, died on January 28 in his home at 912 Fifth Avenue, New York City. His age was 84.

Mr. Eidlitz was educated at Columbia College. At 20 he went to work for Thomas A. Edison as an apprentice mechanic at \$3 a week in the old Bergman plant the inventor established at 17th Street and Avenue A.

Later, at the Edison machine works on Goerck Street, from which grew the present General Electric Company, he was successively tester on the first generators Edison built, inspector of wiring and superintendent of the Edison construction department.

In 1888 Mr. Eidlitz left the Edison organization to become an independent electrical contractor. He continued in this field until 1914 as president of the Charles L. Eidlitz Company. He then gave up contracting, and, as head of Charles L. Eidlitz & Co., engaged in manufacturing and sales of electrical products.

In 1892 Mr. Eidlitz organized the Electrical Contractors Association; in 1901 the National Electrical Contractors Association, of which he became president, and in 1903, he helped form the Building Trades Employers Association, being chosen its first president.

Mr. Eidlitz also served as chairman of the Structural Steel Board and impartial chairman of the Electrical Manufacturers Association of New York, the Electrical Construction Code, the Greater New York Stone Industry and of the Mosaic and Tile Industry.

He belonged to the Edison Pioneers, Delta Upsilon fraternity, the Uptown Club, the General Society of Mechanics and Tradesmen and the Signal Corps Veterans Association, the last a reminder of his service in the war with Spain. He was also an honorary member of many professional and business groups.

Theodore H. Joseph

Theodore H. Joseph, president of the E-J Electric Installation Company, New York City, died of a heart attack on January 31 in Santa Barbara, Calif., where he was vacationing. His age was 75.

He was graduated in 1896 from the Columbia University School of Arts and Mines, and three years later was chief founder of the E-J firm. He had

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Lubring pliers have a ring of porous, oil-impregnated iron in the joint. This ring carries no stress but forces lubrication to assure a smooth, free-working joint.

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been its president since its incorporation in 1911.

Mr. Joseph was a past president and a member of the executive committee of the New York Electrical Contractors Association and a member of the Joint Industry Board of the Electrical Industry in New York. He did much to shape safety rules devised by the National Fire Protection Association and the city's Department of Water Supply, Gas and Electricity.

Active in groups affiliated with his field, Mr. Joseph had been a vice president of the Electrical and Gas Association of New York, a director of Housing Counselors, Inc., and the Monthly Small House Club, Inc. He had been chairman of the Columbia Alumni Fund of the Class of 1896, a member of the Columbia Engineering Schools Alumni Association and board president of the Orienta Point Association in Mamaroneck.

He was a member of the Sons of the American Revolution, United Spanish War Veterans, International Association of Electrical Engineers, United States Navy League and the Society of Naval Architects and Engineers.

AIEE Meeting Attracts 3000 Registrants to N. Y. C.

The AIEE Winter General Meeting, featuring an extensive program of technical, professional and social activities, attracted over 3,000 registrants to New York City's Hotel Statler during the week of January 22nd. Crowded into the 5-day technical section were 73 sessions presenting 324 speakers, 118 committee meetings and 10 inspection trips.

While national defense, through the coordination of power, communications and transportation facilities, was the featured theme, topics ranged from color TV to radiation detection. Between these limits, contractors in attendance evidenced particular interest in sessions on relays, industrial power systems, switchgear and controls, new types of power rectifiers, transformers, insulation, arc and resistance welding, instruments and measurements, heat pumps, electric space heating, capacitors and rotating machinery. Sessions were paralleled in groups of from 4 to 8 with from 2 to 12 speakers discussing each subject. Interest was evident from the lively discussions following the majority of sessions.

Substantial information pertaining to the efficiency of modern weapons, the atom bomb, instruments for indicating radioactivity, plans for mobilization of industry, and defense was presented by a panel of 12 representa-

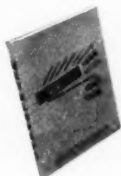
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Level of illumination in the General Office, equipped with WK 4-96-430 "White Knight" Luminaires, was 75 foot candles at 500 hours. Units were spaced on 10' centers and flush mounted on 9' ceiling.



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MURPHY MILLER, owner of the Tennessee Electric Motor Service organization in Knoxville, applies numerous NISA merit-winning methods to the daily maintenance and repair problems submitted to his efficient shop for solution.

tives from government and business. In the discussion, keynoted by W. E. Kelley and Dr. B. S. Wolf of the Atomic Energy Commission, it was mentioned that the atom bomb surpasses ordinary explosives in the speed and thoroughness of devastation; casualties generally are attributed to mechanical causes (30%), nuclear radiation (20%), flashburns and fire (50%); destruction of *consumer equipment* is more complete than damage to *power systems*, resulting in *increased* reserve power after each bombing; and that mobilization can be promoted by (1) dispersing all tools, supplies, trucks and equipment essential to utility operation, (2) calling up emergency personnel after an all-clear signal and a damage-report has been given, (3) developing ingenuity to meet the unexpected, (4) organizing and equipping duplicate staff headquarters, (5) creating liaison groups, (6) setting up emergency radio and messenger communication networks and (7) coordinating your facilities with those of neighboring areas.

In a discussion on control rooms vs NEMA enclosures for electrical equipment, R. G. Rudrow of the Atlas Powder Company mentioned that technological advances have brought control systems for electrical equipment into an era requiring such high capital investment per employee that heavy duty equipment should be used to protect the investment adequately.

Describing single-step voltage regulator application, R. W. Schlie of the Rural Electrification Administration stated that, "The industry is cognizant of the fact that pre-war estimates of load growth have been far exceeded by rapid postwar expansion and that low voltage problems on rural circuits highlight the present need for inexpen-

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sive voltage correction equipment". Advantages of single-step regulators, he said, included economy, simple control, minimum maintenance, fixed voltage limits, reduced weight and fine adjustment.

The residential use of heat pumps in various sections of the country was reviewed by E. R. Ambrose, American Gas and Electric Service Corp., who concluded that, "It is believed that the total annual kilowatthour consumption of the heat pump system must be reduced in order to be in a more favorable competitive position with conventional systems before wide public acceptance can be expected."

On the same topic, Edwin F. Snyder, Minneapolis-Honeywell Regulator Co., added, "The nature of a heat pump installation calls for integration of every phase of control to give complete satisfaction. There are two separate but inter-related control problems: the compressor and its auxiliary equipment must be controlled and the distribution of the heating or cooling medium to the space calls for close control."

The possibility of giant transformers much larger than those now in use was analyzed by W. C. Sealey of the Allis-Chalmers Mfg. Co., who cited the tremendous size of the transformer core on the now-in-use 300-million volt betatron at the University of Illinois. "Although the cost of field erection on a per pound basis of material is greater than that of factory construction," he said, "the saving in weight and the improvement in efficiency inherent in a larger unit for transforming a given kva., may at



B. J. Mulvey, industrial engineer, Wire & Cable Div., General Electric Company, Bridgeport, Conn., demonstrates oil resistance of thermoplastic insulated building wires to Illinois electrical inspectors at their recent convention in Chicago.

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Electrical contractors rely on Sylvania COP starters because they immediately cut out flickering tubes. Insure against excessive starter wear and ballast burnouts. Equipped with a push-button for instant reset when new lamp is inserted. Remember COP... public guardian No. 1 for any fluorescent installation.

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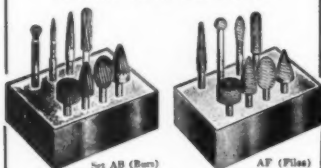
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MARTINDALE PROTECTIVE MASKS
Weigh less than 1/2 ounce.



Write for 64-page Catalog describing these and many other products for Industrial Maintenance, Safety and Production.

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NEW PRESIDENT of the Electric Association in Chicago, Harry Alter (left), president of Harry Alter Company, receives the gavel from association treasurer George L. Seaton, general manager of the Illinois Bell Telephone Company. Mr. Seaton officiated in absence of retiring president A. H. Kahn, district manager of the General Electric Supply Corporation.

some future date make the construction of transformers much larger than can be shipped by rail an economical procedure."

An evaluation of hermetically sealed electric circuit components was given by E. B. Steinberg, Remington Rand. "Assets of hermetic sealing", he stated, "include the alleviation of adverse atmospheric and environment conditions, the reduction of servicing and maintenance to a factory-exchange basis, and the increased life due to protected insulation and contacts. Considering all features, a decrease in initial cost could make hermetically sealed components of the plug-in unit construction very attractive and useful in industrial control."

A report by the AIEE relay project committee brought out the fact that "the relaying of interconnections between industrial and utility generating stations presents a problem which can be solved by standard relays and relay schemes in accordance with the requirements of individual applications. Quick separation is usually beneficial to both utility and industrial. Economic considerations play a large part in many interconnections and frequently on that account relay applications fall short of desirable operation".

Industrial power system protection was discussed by H. G. Barnett, Westinghouse Electric Corp., who stated that, "An essential part of distribution planning is choosing and applying proper protective devices such as fuses, thermal breakers, low voltage air circuit breakers, relays and power circuit breakers. The protective equipment must coordinate with the devices at the loads and it may be necessary in many cases to modify a number of protective devices to meet the requirements of the generating plant supplying power to the industrial load." Various types of distribution systems

AUSTIN "DRIVE-IN" CABLE STAPLES



Flat across top — no spreading or buckling.

The shoulders are square and strong — drives easily and accurately.

Long taper to point — staple held firmly at the first top of hammer.



No. 360

Made for armored cable. Available without indentation in top for non-metallic sheathed cable — Cat. No. 361

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3185

and protective devices were analyzed to illustrate his thesis.

Continuing the discussion on various phases of distribution, D. S. Brereton, General Electric Company, described the power system installed in the General Accounting Office Building in Washington; T. O. Zittel, Bethlehem Steel Co., analyzed the system in one of their sheet steel plants, and T. W. Dugdale, Indiana and Michigan Electric Co., listed the advantages of the split bus substation serving the Bendix plant in South Bend.

High voltage motor starters coordinated with distribution switch gear was the topic of a discussion by T. B. Montgomery, Allis-Chalmers Mfg. Co. Setting the definitive values of 5000-volts and 50,000-kva. interrupting capacity as the changing limit between motor controls and switchgear, he stated that, "In the switchgear sizes, interrupting ratings are necessary, and the trend in both controller and circuit breaker design has been to the air-break type."

H. J. Chanon to Manage G-E's Lighting Institute

The Lighting Institute at Nela Park has been established as a separate division of General Electric's Lamp Department, and Henry J. Chanon, of Cleveland, has been appointed its first manager. In the past the Institute has been an activity of the Engineering Division.

Fred F. Harroff, G-E vice president and general manager of the Lamp Department, in announcing the reorganization, attributed the change to the



NEW OFFICERS of the Electric Motor & Service Association, Chicago (Central District Chapter, NISA) are: vice-president—J. G. Lessel, Central Motor & Repair Co., Chicago; president—Baird Rogers, Rockford Power Machinery Division, Midstates Industrial Corp., Rockford, Ill.; secretary—H. W. Reeve, Inland Industrial Electrical Service Co., Chicago; treasurer—E. K. Nettgen, Arthur Wagner Co., Chicago.

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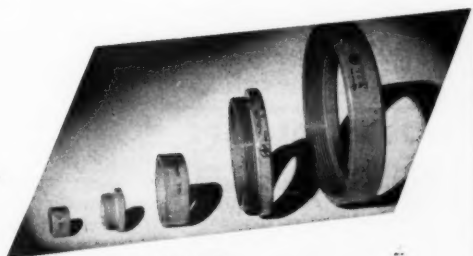


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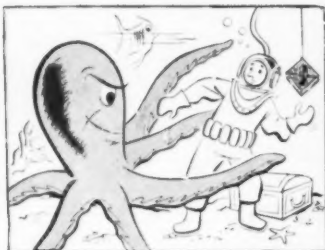
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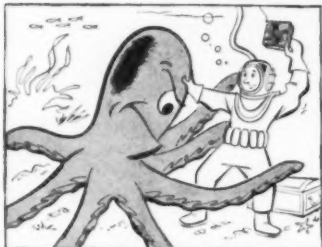


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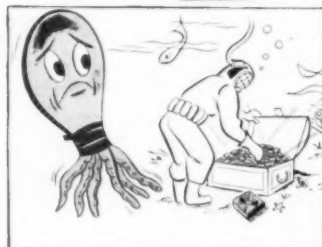




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"CHURCH LIGHTING offers a profitable lighting market," Edgar M. Andrews (right) tells his son, Edgar, Jr.—and he should know. Now completing the installation of lighting and wiring in three separate churches, he has sold over 100 church lighting jobs during the more than a quarter-century he has been operating his electrical contracting business in Richmond, Va. Promoting sales through most of the popular sales techniques, with special emphasis on personal calls, Edgar M. Andrews, Inc., has also pioneered in the lighting of banks, offices, stores and industrial shops in the Richmond area for many years.

increasing importance of the Institute arising out of its task of contributing to the national defense program. In this connection it will demonstrate how good lighting can promote increased industrial production, efficiency, safety, morale and economy, he said.

Chanon, with 25 years' experience in the lighting field, comes to his new position from the Lamp Department's Buckeye Sales District, with headquarters in Cleveland, where he served during the past nine months.

NPA Urges Conduit Conservation

National Production Authority and the Electrical Conduit Industry Advisory Committee are recommending all users to conserve wherever possible in the use of galvanized electrical conduit or electrical metallic tubing. This action was taken February 5, when NPA met with the Committee in Washington to consider possible methods for conserving zinc, now in critically short supply.

"The use of rigid black enamel conduit should be promoted by the industry for indoor use, and wherever the Code permits," the Committee stated.

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WACO'S Speedlock assembly is fast and simple. Speedlock has no bolts or clamps to tighten or adjust—no loose parts to become lost. A simple, but rugged lock drops into place to hold end frames and cross braces in rigid alignment.

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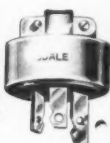
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Package: 20. Weight: 4
lbs.
Cat. No. 1201.



POLARIZED SINGLE RECEPTACLE

Molded bakelite with
brass contacts, brass
screws and terminals. Fits
all standard single outlet
plates. 20A—250V 3 Wire.
Carton: 10. Standard
Package: 30. Weight 11
lbs.

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POLARIZED DUAL-PURPOSE SINGLE FLUSH RECEPTACLE

Molded Bakelite, Brass
Screws, Bronze contacts
mounted on brass terminals
assure positive heat-
free conductivity. Rust and
corrosion resistant coating
on strap. Accommodates
Parallel and three wire
caps. Fits all standard
single outlet plates. 10A—
250V; 15A—125V—3 Wire.
Carton: 10. Standard
Package: 50. Weight: 18
lbs.

Cat. No. 1030.



If your regular electrical wholesaler cannot supply you with RODALE Polarized Caps and Receptacles, please let us know. We will be pleased to send you the names of the wholesalers in your area who are able to fill your RODALE needs.



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NPA officials pointed out that present "DO" reserves for hot and cold rolled strip steel probably will be stepped up for special defense demands, making it urgent that conduit be conserved wherever possible.

Industry representatives said that substantial amounts of zinc would be saved by halving the present requirements for conduit coatings. They recommended a reduction in the amount of zinc on galvanized conduit from a "Preece Test" four-dip requirement to two dips for indoor use, with two protective coats of weatherproof paint for outdoor use.

M. M. Brandon, vice-president of Underwriters' Laboratories, Inc., and a member of the Conduit Industry Advisory Committee, told the committee and NPA that underwriters are willing to accept emergency standards approved by the National Electrical Code Committee, in the interests of national defense. Further steps for zinc and steel conservation in electrical conduit and EMT are under consideration, but it is not believed NPA will take official measures if industry and users cooperate fully in conservation of conduit, unless the seriousness of these shortages continues to increase.

Capacitors and Power Factor

Power-factor improvement of industrial installations by the use of capacitors is the subject of "Capacitors for Industry". This text offers a clear and lively presentation of theory and application. The explanatory treatment is directed toward the solution of everyday working problems and avoids complex mathematics. In addition to numerous photographs and diagrams, a wealth of practical application data is tabulated and graphed for handy reference. Illustrative examples present a step-by-step procedure for the quick solution of capacitor problems, from selection to installation.

The authors, W. C. Bloomquist, C. R. Craig, R. M. Partington, and R. C. Wilson, are qualified application and design engineers. Their well balanced work in this book includes such considerations as: Power-Factor Fundamentals, Instruments and Measurements for Power-Factor Studies, Release of Power System Capacity, Voltage Improvement, Application of Capacitors to Motors and Generators, Automatic Control Equipment, and Capacitor Installation and Maintenance. A brief chapter is devoted to general or functional specifications.

Published by John Wiley and Sons, Inc., 440 Fourth Ave., New York, New York, the copy is priced at \$4.50.

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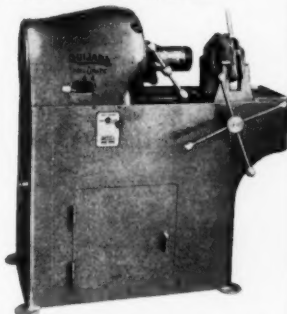
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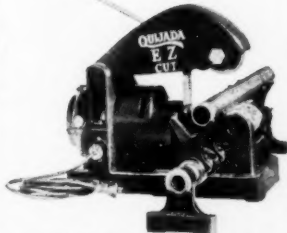
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MAXIMUM CAPACITY MINIMUM SPACE (FROM PAGE 81)

set flush in the wall (Fig. 2) with a protruding header pull box for branch circuit conduits.

Supplementing the advantages gained by the carefully engineered power and lighting system was the attention directed to such problems as materials handling, heating and ventilation—all items which have a direct bearing on employee efficiency and productive capacity.

Twenty-nine separate craneways and monorail systems, with capacities up to 10 tons, solved the problems of suspending loads directly from the highly-adaptable H-section truss structures. Interdepartmental traffic is handled by a fleet of fork lift trucks which permit full use of the 14-ft. height in storage areas.

In the absence of conventional roof monitors, ventilation is provided by 43 combination heating and ventilating units mounted singly and in groups on roof-truss platforms. Each unit handles 14,400 cu. ft. of air per minute; has a heating capacity up to 1½-million Btu's per hour; provides frequent air changes throughout the plant. In summer, this system is supplemented by an evaporative roof cooling system.

All of the dust, heat and fumes created by the many metalworking and processing operations necessary in the manufacture of duplicating machines and equipment, are removed at their source. Thus uniformly good atmospheric conditions can be maintained in these departments without isolating operations in separate rooms.

The office building houses the administrative and clerical offices, cafeteria, and chemical research laboratory on the second floor.

Design, engineering and construction of this modern plant was handled by The Austin Company. Electrical facilities for the manufacturing areas were installed by Electrical Contractors, Inc., of Chicago; those for the administration building by Henry Newgard & Co., also of Chicago.

FRONTIERS FOR ELECTRICAL PROGRESS

The July issue of **ELECTRICAL CONSTRUCTION AND MAINTENANCE** will include an appraisal of modern practices and trends in load analysis for wiring design.

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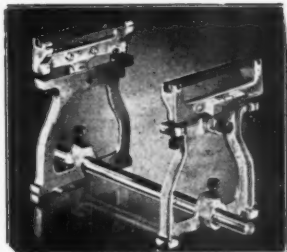
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Used by many large manufacturers for balancing armatures, pulleys, fan blades, grinding and buffing wheels and many other rotating parts.

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209	9"	100	Bench	4"	10"	3		\$24.75
220	20"	100	Wall	6"	12"	7		37.50
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Interchangeable aerial lugs and base fittings.

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PLANNED MAINTENANCE [FROM PAGE 74]

personnel must possess forcefulness and diplomacy. They must possess the ability to get along with people, and to "sell" the need of maintenance to everybody. They should also invite participation in plant engineering work. Such cooperation will pay dividends for the whole plant, if value of uninterrupted production is continuously emphasized to all. Supervisors must consistently follow the work performed by inspectors. Due to the non-uniform nature of maintenance work, establishment of routines and time studies are different, and execution of orders should be followed through with spot checks on jobs. Handling of complaints must be done in diplomatic fashion to locate actual trouble and segregate the possibility of personal dislikes and misunderstandings.

It is a very good policy for routine jobs to have specifications written in definite, complete and simple language and have jobs scheduled in advance as much as possible.

Check lists can be established for many jobs to provide ease of operation. Management should see that machines are available for routine inspection and that friendly relations prevail between production and maintenance groups. It must be made clear that no "civil war" tactics will be tolerated.

Adequate Stocks

Good storage room facilities and availability of needed material at all times play a vital part in a good plan. Advance purchasing of material of high engineering standards to assure high quality of jobs is vital. Spare motors and spare parts represent a considerable investment. To avoid high expense, spare stock may be limited to only key equipment, thus expense can be limited by careful selection of really needed parts and to those applications which are the most essential, the breakdown of which will result in high enough losses so that spare part investment will pay for itself. Some needed spares can be rented or obtained on contract with good service organizations.

The overall performance of a plant maintenance department, operating on a definite budget, will more likely justify itself than one which is operating on a budget hidden in operational costs of other departments. Of course,

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Now also available with a shallow
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the electrical maintenance department, like any other department, must live up to its budget and endeavor, and in its annual analysis of costs, justify its existence. Also, it must be on a continuous look-out for better methods.

Organizing Program

The basis of a sound and economical maintenance plan is as follows:

1. An engineering survey of conditions in a plant and preparation of a technical report—recommendation for maintenance of electrical equipment.
2. Based on this report the establishment of needed repair facilities, like general repair shop, special shops, tools, etc. Building of competent staff of specialists, engineers and electricians. Organization of office procedures, records, etc. Follow-up and enforcement of established routine.
3. Periodical check on established plan to permit possible corrections and improvements. Economic study of effects of plan on production schedules and output.

All these functions can be performed by a plant itself or with the assistance of outside firms. If a complete staff of specialists is not available within the firm itself, a survey for establishment of a plan can be successfully performed by outside concerns which specialize in such consulting work.

Contracting for Maintenance

Expensive repair facilities usually are not justified for individual concerns, and the common procedure is to use reliable electric shops established in the vicinity of the plant. Complete or partial replacement of a plant's maintenance force by men from outside concerns, in many cases, is an economically sound procedure, particularly where full time employment of additional men is not justified. Use of a firm's own maintenance force with supervision by outside experts, in many cases, offers a good solution to a plant's maintenance problem. This solution relieves management of the responsibility for proper operation of electrical equipment, and permits employment of less experienced personnel to be supervised by outside experts under contract. This supervisory type of maintenance can only be performed by well organized and experienced firms which specialize in electrical preventive maintenance. To get the best results, one thing is certain, a survey-study must invariably precede adoption of any maintenance plan, electrical or otherwise.

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EVERY chief electrician, plant engineer, maintenance man and electrical or heating contractor needs this manual. It points out the economical advantages of heating electrically with Electromode heaters, shows the various types available, tells how to figure proper sizes for specific jobs, shows control equipment, mounting and wiring diagrams, and includes estimating sheet.

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1. Patented one-piece sections—no separate frames. Each section folds flat. No wrenches, wing nuts, bolts or loose parts.
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OFFICES IN ALL PRINCIPAL CITIES

STREAMLINING A STREET LIGHTING PROJECT

[FROM PAGE 77]

is ready for the second pull. Meanwhile, the reel trailer—at the opposite end of the run—is moved to the next feed-in location.

In the interim, pre-assembly operations are taking place at the field yard for the lighting crew. Here the arm and head (socket) of the lighting standard is being assembled and wired (wire riser in pole cut to length). The assembled arms, standards, lamps and glass globes are then trucked to the various locations before the installation crews take over. One four-man "make-up" crew pulls the cable in the standard, mounts and aligns the arm with the base, and installs the lamps and glass globe while the pole is still on the ground. The possibility of future lamp trouble is minimized by having one man install the cut-outs and lamps in the sockets of all poles. A second boom-truck crew of four men set and align the standards and make final connections.

To speed up pole alignment, K-W engineers designed and built an instrument which uses the plumb-bob principle. Formerly, it took three men—two "sighters" at right angle positions and one man to manipulate the adjustment nuts at the base—up to 20 or 25 minutes to align a standard. Now one man can do the job, alone, in about seven minutes.

The simple device consists of a Monel metal split-ring which can be clamped around the standard. Sets of metal knobs center the ring around poles of different diameters. Cylindrical plumb-bobs are suspended from four automatic reels mounted to the outer rim of the ring (at 90-degree points). Lateral distance from rim to reel is sufficient for the bobs to clear the base of the standard. While manipulating the adjustment nuts at the base, the mechanic watches the four plumb-bobs. When each bob clears the base, the standard is plumb.

A series of code markings are used on the cover of the standard base to indicate whether the pole was plumbed and connected. Supervisors can easily spot and check unfinished standards while cruising along on their inspection rounds.

Much credit is due the use of modern installation methods and the proven fact that careful planning, organization and maximum use of technical know-how and power equipment pay off handsomely.

Hykon TIME AND LABOR SAVING TOOLS



HYKON WIRE MEASURING UNIT

A complete, compact unit for all wire measuring. Both coils left neat for easy handling. Unit is portable.

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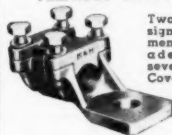
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is no better than its
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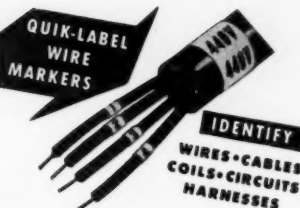
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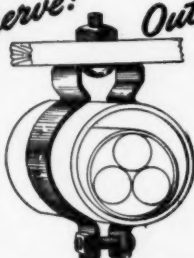
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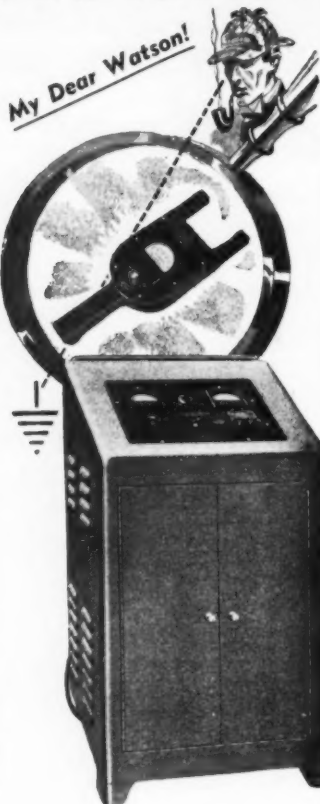


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DAMAGE TO PLANT EQUIPMENT**

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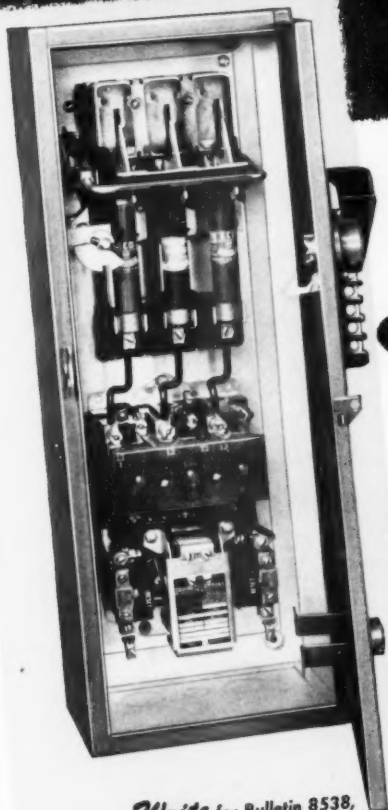
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DESIGN LEADERSHIP



Write for Bulletin 8538,
SQUARE D COMPANY, 4041 North
Richards Street, Milwaukee 12, Wis.

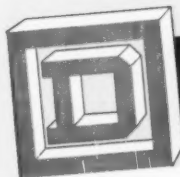
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and Longer Motor Starter Life

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